PHASE 2
QUINDARO – RIVERSIDE LEVEES AND STRUCTURES

PHASE II

DIVISION 1 – GENERAL REQUIREMENTS

01100	General
01312A	Quality Control System (QCS)
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SECTION 01100

GENERAL

PART 1 GENERAL

1.1 INQUIRIES

Pursuant to SECTION 00100, any inquiries regarding this Invitation, before bids are opened, should be addressed to the District Engineer, Kansas City District, Corps of Engineers, 700 Federal Building, Kansas City, Missouri 64106, ATTN: Mr. Richard Bateman. Inquiries for which oral explanation or advice on the plans and specifications will suffice may be referred to Mr. Bateman by calling Area Code 816-983-3604. Telephone calls concerning the mailing of plans and specifications should be made to Contracting Division at Area Code 816-983-3975. Collect telephone calls will not be accepted. (KCDO APR 84)

1.2 ON-SITE BURNING

On-site burning in general will be allowed under the following conditions:

a. The Contractor shall obtain approval of the local fire marshals;

b. The Contractor shall use a smoke curtain and below ground pit;

c. The Contractor shall include on-site open burning in his Plan of Operations, and shall submit it for the approval of the Contracting Officer;

d. The Contractor shall obtain a burn permit from the Missouri Department of Natural Resources' Regional Office; and

e. The Contractor shall have applied for and been granted a permit to burn with restrictions from the local Government.

Failure of the Contractor to meet these conditions in a timely manner will not constitute a basis for claims against the Government. The Contractor may use other processes to remove the materials, such as chipping or off-site disposal, if this method is cost-comparable to the on-site burning method.

All on-site burning will require the use of an Air Curtain Destructor. An Air Curtain Destructor is an air pollution control device designed to increase burning efficiency, thereby reducing air contaminant emissions during open burning.

A burning permit is a permit that must be applied for and granted in order to burn with restrictions from the local and State Governments. The Contractor must send permit applications to the local and State Regional Offices that have jurisdiction.

A completed application submitted to the Missouri Department of Natural Resources' Regional Office which has jurisdiction over this area will contain the following:

a. The name, address and telephone number of the person submitting the application;

b. The type of business or activity involved;

c. A description of the proposed equipment and operating practices, the type, quantity and composition of trade wastes and vegetation to be burned, and expected composition and amount of air contaminants to be released to the atmosphere, if known;

d. The schedule of burning operations;

e. The location where the open burning will be performed;

f. Reasons why no method other than open burning is feasible; and

g. Evidence that the fire control authority and other local agencies that have jurisdiction over the area have approved the proposed open burning.

For more information, call or write:

Missouri Department of Natural Resources
Kansas City Regional Office
500 N.E. Colbern Road
Lee's Summit, MO 64086-4710
(816) 622-7000 office
(816) 622-7044 fax

1.3 SUPERINTENDENCE OF SUBCONTRACTORS

(a) The Contractor shall be required to furnish the following:

(1) If more than 50% and less than 70% of the value of the contract work is subcontracted, one superintendent shall be provided at the site and on the Contractor's payroll to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

(2) If 70% or more of the value of the work is subcontracted, the Contractor shall be required to furnish two such superintendents to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

(b) If the Contracting Officer, at any time after 50% of the subcontracted work has been completed, finds that satisfactory progress is being made, he may waive all or part of the above requirement for additional superintendence subject to the right of the Contracting Officer to reinstate such requirement if at any time during the progress of the remaining work he finds that satisfactory progress is not being made.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section SUBMITTAL PROCEDURES:

SD-08 Statements

Accident Prevention Plan; GA-RE.

The requirements included in Section 01 of EM 385-1-1 shall be followed by the Contractor when preparing the Accident Prevention Plan. The plan shall be prepared for all sites and shall include, but is not limited to, each of the topic areas listed in Table 1-1 therein and the requirements of paragraph SAFETY AND HEALTH PROVISIONS; each topic shall be developed in a concise manner to include management and operational aspects.

Equipment Lists; GA-RE, Guarantees; GA-RE, and Warranty Service Call Plan; GA-RE

Provide equipment lists for installed equipment, guarantees and warranty service call contacts thirty days prior to final inspection and acceptance of the work.

SD-04 Drawings

As-Built Drawings and CADD Files; GA-RE

Submit as-built shop drawings, as-built construction drawings and CADD files at the time of final inspection, prior to acceptance and final payment by the Government.

Shop Drawings; GA-RE.

The Contractor shall submit complete shop drawings and erection drawings for the sluice gates, for appurtenant items, and for the gate anchorage systems for approval prior to fabricating any gate. Drawings shall include catalog cuts, templates, fabrication, erection and assembly details, and grade and class of materials. Elements of fabricated items inadvertently omitted from contract drawings shall be indicated on submittals.

Electrical Distribution System; GA-RE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

SD-19 Operation and Maintenance Manuals

Operations and Maintenance Drawings; GA-RE

Submit O & M manuals thirty days prior to final inspection and acceptance of the work.

1.5 APPLICATION OF WAGE RATES

The inclusion of the Davis-Bacon Act General Wage Decision or the Service Contract Act Wage Determination in the solicitation is a statutory requirement. it is not a representation by the U.S. Army Corps of Engineers that any specific work task can be performed by any specific trade. Which work tasks can be performed by what trades depends on and is determined by the prevailing area practice for the local area where the contract is being performed. It is the sole responsibility of the bidder to determine and comply with the prevailing area practice. inquiries regarding a prevailing area practice should be directed to the Corps of Engineers, Contractor Industrial Relations Specialist (telephone number 816-983-3723) or to the Department of Labor Regional Wage and Hour Division.

Application of wage rates and fringe benefits: For the application of the wage rates and fringe benefits contained in the Decision of the Secretary of Labor, attached to and a part of this contract, all work shall be considered Heavy Construction.

1.6 PAYMENTS TO SUBCONTRACTORS

The Contractor's attention is directed to CONTRACT CLAUSE titled "Payment Under Fixed-Price Construction Contracts." In addition to the requirements set forth in the referenced paragraph, the Government will reimburse the Contractor, upon request, for amount of premiums paid by the subcontractors for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor furnishes evidence of full payment to the surety.

1.7 PAYMENTS TO CONTRACTOR (KCD MAY 90 - FORMERLY FAR 52.2/9101(a))

The following is an example of a Contractor's release of claims clauses required to comply with the provisions of paragraph (h) of the CONTRACT CLAUSE titled "Payments Under Fixed-Price Construction Contracts":

RELEASE OF CLAIMS

The undersigned Contractor under contract dated _____, 2000, between the United States of America and said Contractor for the _____ located at _____, in accordance with paragraph (h) of the CONTRACT CLAUSE titled "Payments Under Fixed-Price Construction Contracts" of said contract, hereby releases the United States, its officers, agents, and employees from any and all claims arising under or by virtue of said contract or any modification or change thereof except with respect to those claims, if any, listed below:

(Here itemize claims and amounts due.)

1.8 PARTNERING

The Government intends to encourage the foundation of a cohesive partnership with the Contractor and its subcontractor. This partnership will be structured to draw on the strengths of each organization to identify and achieve mutual goals with the intent to complete the Contract within budget, on schedule and in accordance with plans and specifications. This partnership will be bilateral in makeup, and participation will be totally voluntary. Any cost associated with implementing this partnership will be agreed to by the Contractor and the Government, and will be shared equally with no change in Contract price. To implement this partnership initiative, it is anticipated that thirty (30) days after Notice to Proceed, a team building workshop will be conducted. Follow-up workshops will be held periodically throughout the duration of the Contract as agreed to by the Contractor and the Government.

1.9 PROSPECTIVE CONTRACTOR RESPONSIBILITY

Each bidder shall furnish, within 3 calendar days after receipt of request therefor, data which will show the bidder's ability to perform the work or services required by this Invitation for Bids. Such data shall include as a minimum: Bank certification of financial capability, or a financial statement not over 60 days old, which will be treated as confidential (if

over 60 days old, a certificate shall be attached thereto stating that the financial condition is substantially the same or, if not the same, the changes that have taken place); names of commercial and financial reporting agencies from whom credit reports may be obtained; trade creditors; name and address of bonding company; business and construction experience; past record of performance of Government contracts; and construction plant and equipment available for this job, with resume of work in progress or other data that will assure that the bidder is in a position to perform the work within the time specified.

In addition, if the bid exceeds $1,000,000, the bidder shall furnish upon request, a certified statement listing:

(a) Each contract awarded to him within the preceding three-month period exceeding $1,000,000 in value with brief description of the contract.

(b) Each contract awarded to him within the preceding three-year period not already physically completed and exceeding $5,000,000 in value with brief description of the contract.

(c) If the prospective Contractor is a joint venture, each joint venture member will be required to submit the above defined certification. There shall also be furnished any other available information which will serve to substantiate the bidder's qualifications as a responsible prospective Contractor. (KCD APR 84)

1.10 LABORATORY AND TESTING FACILITIES

The Contractor shall provide and maintain all measuring and testing devices, laboratory equipment, instruments, transportation, and supplies necessary to accomplish the required testing. All measuring and testing devices shall be calibrated at established intervals against certified standards. The Contractor's measuring and testing equipment shall be made available for use by the Government for verification of their accuracy and condition as well as for any inspection or test desired pursuant to the CONTRACT CLAUSE titled "Inspection of Construction." The location of the laboratory shall be convenient to the site such that test results are available prior to proceeding with the next sequential phase of the work. (KCD)

1.11 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

(a) This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the CONTRACT CLAUSE titled "Default: (Fixed Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied (for all work except for construction of closure structures Q1 and Q3. For weather provisions for Q1 and Q3 closure structures, see subparagraph (d) below :

(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

(b) The following schedule of monthly anticipated adverse weather delays

is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY

WORK DAYS BASED ON (5) DAY WORK WEEK

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(16)	(11)	(6)	(7)	(7)	(8)	(6)	(5)	(6)	(5)	(3)	(9)

(c) Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the Contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled work day. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph b, above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the CONTRACT CLAUSE titled "Default (Fixed Price Construction)." (ER 415-1-15)

(d) For work on the closure structures Q1 and Q3, the Contractor will be required to complete all work requiring single track operation, for both Q1 and Q3, within 4 working weeks total. At the Contractor's request, the COR may request the Railroad Owner to extend the period of single track operations in one-day increments not exceeding five (5) in total if inclement weather prevents the Contractor from performing construction operations. The granting of additional weather days will be at the sole discretion of the Railroad Owner. If the request is not approved, the Contractor shall remain responsible for completing work requiring single track operations within 4 working weeks. Also, once the period of single track operations has begun, the scheduled time for completion of work requiring single track operations will be measured in consecutive days. There will be no starting and stopping of single track operation periods.

1.12 REQUIRED INSURANCE SCHEDULE

In accordance with CONTRACT CLAUSE titled "Insurance - Work On A Government Installation," the Contractor shall procure and maintain during the entire period of his performance under this contract the following minimum insurance.

Type	Amount
Workmen's Compensation State Statute	coverage complying with applicable
Employers' Liability	minimum amount of $100,000.00
General Liability on Comprehensive Form of Policy	minimum limits of $500,000 per occurrence for bodily injury which includes, but is not

	limited to, insurance for all work required herein
Comprehensive Automobile Liability	minimum limits of $200,000 per person and $500,000 per occurrence for bodily injury, and $20,000 per occurrence for property damage
Railroad Protective Insurance	As directed in Specification Section SPECIAL SCHEDULING, paragraph, Q1 AND Q3 CLOSURE GAP STAGING AND CONSTRUCTION REQUIREMENTS

1.13 CONTRACTOR-FURNISHED EQUIPMENT DATA

At or before 30 days prior to final inspection and acceptance of the work, the Contractor shall submit the data mentioned in the following subclauses.

(1) Equipment List. An itemized equipment list showing unit retail value and nameplate data including serial number, model number, size, manufacturer, etc., for all Contractor-furnished items of mechanical equipment, electrical equipment, and fire protection systems installed under this contract.

(2) Guarantees. A list of all equipment items which are specified to be guaranteed accompanied by a copy of each specific guarantee therefor. For each specific guaranteed item, a name, address, and telephone number shall be shown on the list for subcontractor who installed equipment, equipment supplier or distributor and equipment manufacturer. The completion date of the guarantee period shall correspond to the applicable specification requirements for each guaranteed item.

(3) Warranty Service Calls. The Contractor shall furnish to the Contracting Officer the names of local service representatives and/or Contractors that are available for warranty service calls and who will respond to a call within the time periods as follows: 4 hours for heating, air-conditioning, refrigeration, air supply and distribution, and critical electrical service systems and food service equipment, and 24 hours for all other systems. The names, addresses, and telephone numbers for day, night, weekend, and holiday service responses shall be furnished to the Contracting Officer and also posted at a conspicuous location in each mechanical and electrical room or close to the unit.

1.14 DATE OF SAFETY AND HEALTH REQUIREMENTS MANUAL (EM 385-1-1)

(a) The date of the U.S. Army Corps of Engineers Safety and Health Requirements Manual in effect on the date of this solicitation is 3 September 1996. See Section 00700, Contract Clause titled "Accident Prevention." (KCD 18 DEC 1992)

(b) Section 06.I of EM 385-1-1 is deleted. Job hazard analysis for confined space entry procedures is still required, as per 01.A.09 of EM 385-1-1. OSHA Standards 29 CFR 1910.146 or 29 CFR 1926 shall apply.

1.15 COMPLIANCE WITH OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

The Contractor shall comply with OSHA standards as well as the Corps of Engineers General Safety Requirements Manual (EM 385-1-1) latest edition at time of award of construction contract. The OSHA standards are subject to change and such changes may affect the Contractor in his performance under the contract. It is the Contractor's responsibility to know such changes and effective dates of changes. (KCD APR 84)

1.16 CONSTRUCTION EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

Whenever a modification or equitable adjustment of contract price is required, the Contractor's cost proposal for equipment ownership and operating expenses shall be as set forth in SPECIAL CLAUSE titled "Equipment Ownership and Operating Expense Schedule." A copy of EP 1110-1-8 "Construction Equipment +Ownership and Operating Expense Schedule" current dated at award of construction contract can be ordered from the Government Printing Office (GPO) by calling Telephone No. 202-512-1800.

1.17 SHOP DRAWINGS

The Contractor's attention is directed to clause "Specifications and Drawings for Construction" of the Contract Clauses.

1.18 DRAWINGS

(a) Submittal Procedures. See Division One SECTION: SUBMITTAL PROCEDURES.

(b) Shop Drawings shall be submitted in ample time to secure approval prior to the time the items covered thereby are to be delivered to the site. ENG Form 4025 and 4026 shall be used for the transmittal of shop drawings. Unless otherwise specified, shop drawings shall be submitted not less than 30 days before commencement of fabrication of fabricated items and not less than 15 days before delivery of standard stock manufactured items. Where materials are stock with the manufacturer, catalog data, including specifications and full descriptive matter, may be submitted as shop drawings. When catalog includes non applicable data, the applicable data shall be clearly designated and identified by item number, item name, and name of manufacturer. Shop drawings submitted (including initial and final submittals) shall be reproductions on high quality paper with clear and legible print. Drawings shall generally be bordered a minimum of one inch and trimmed to neat lines and unless otherwise specified, the minimum scale shall be 3/8-inch to the foot. Shop drawings quality will be subject to approval. Each shop drawing, including catalog data, shall be identified with a title block including the name of Contractor, contract number, name and location of project, and name of item of work or structure to which the shop drawing applies. Material fabricated or delivered to the site before approved shop drawings have been returned to the Contractor will be subject to rejection. NO CONSTRUCTION OR INSTALLATION SHALL BE DONE FOR ANY ITEM REQUIRING SHOP DRAWINGS, UNTIL ALL SHOP DRAWINGS FOR THAT ITEM HAVE BEEN APPROVED.

(c) As-Built Shop Drawings: Upon completion of the work under this contract, the Contractor shall furnish five complete sets of prints or one complete set of reproducibles of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the equipment is completed and accepted. The quality of the reproducibles and prints is subject to approval.

(d) As-Built Drawings: The Contractor shall maintain three separate sets of red-lined, full scale, as-built construction drawings marked up to fully

indicate as-built conditions. These drawings shall be maintained in a current condition at all times until completion of the work, and shall be available for review by Government personnel at all times. All variations from the contract drawings, for whatever reason, including those occasioned by modifications, optional materials, and the required coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the contract drawings. In addition, the Contractor shall indicate on the As-Built Drawings, the brand-name, description, location, and quantity of any and all materials used which contain asbestos. The Contractor shall also be responsible for updating the Government-furnished CADD files to reflect the current as-built conditions throughout the duration of the project. The updated CADD design files shall be maintained in the Intergraph Microstation format consistent with the graphic standards established in the CADD contract drawings provided by the Government. The Contractor will be provided a copy of the Tri-Service CADD standards to facilitate his efforts in the maintenance of design files. The updated CADD files shall be reviewed by the Government on a monthly basis during the progress payment evaluation. The Contractor shall be prepared to demonstrate the status of the updated CADD files in his on-site office. The as-built utility drawings shall show locations and elevations of all underground new utilities and existing utilities encountered, including dimensions from permanent structures and/or survey locations. The submittal requirements for as-built utility drawings shall be shown as separate activities on the Contractor-prepared network analysis. Upon completion of the work, the marked-up drawings and the updated CADD files shall be furnished to the Contracting Officer on 8 mm tape or CD. In multiphased construction where portions of a system are to be turned over to the user prior to completion of the project, the marked-up drawings for that portion shall be furnished to the Contracting Officer at that time.(MRD ltr 30 Oct 70 and KCD 8 Apr 91)

(e) CADD Files: The Government will provide to the Contractor, within 30 calendar days after Notice of Award, copies of the CADD computer files of the contract drawings for the production of as-built drawings. These files will be in Intergraph Microstation format. The Government provides no warranty, expressed or implied, of the CADD computer files. The Contractor shall assume all responsibility to verify the CADD drawing files. The Contractor will not utilize the CADD drawing computer files to resolve dimensional or other discrepancies. The Government will not guarantee the measurable accuracy of the CADD drawing computer files.

(f) Purchase Orders: Each purchase order issued by the Contractor or his subcontractors for materials and equipment to be incorporated into the project, shall be maintained on file at the Contractor's field office for inspection and review by Government representatives. Each purchase order shall (1) be clearly identified with applicable DA contract number, (2) carry an identifying number, (3) be in sufficient detail to identify the material being purchased, (4) indicate a definite delivery date, and (5) display the DMS priority rating. At the option of the Contractor, the copies of the purchase orders may or may not indicate the price of the articles purchased. (MRD Ltr 22 Oct 74)

1.19 SPECIAL REFERENCES

(a) Shop Drawings. Bidder's attention is directed to paragraph titled "Shop Drawings." The basic requirements for Shop Drawings are set forth in this section.

(b) Approved Equal. Bidder's attention is directed to FAR for "Approved

Equal."

(c) Payment to Subcontractors. Bidder's attention is directed to paragraph titled "Payments to Subcontractors."

1.20 DIFFERENCES IN DRAWINGS

In addition to the provisions of CONTRACT CLAUSE paragraph "Specifications and Drawings for Construction," the structural drawings shall govern in cases where they differ from the architectural drawings.

1.21 LAYOUT OF WORK (1965 APR OCE)

(a) The Government will establish the following base lines and benchmarks at the site of the work:

Levees and Local

Protection Work - 1 base line at centerline or levee or floodwall
- 1 base line for each principal structure
- bench marks at approximately 1 mile intervals and at each structure
- or PIs

Relocation Projects - alignment survey base lines
- bench marks at wide intervals and at each principal structure

(b) From the base lines and bench marks established by the Government, the Contractor shall complete the layout of the work and shall be responsible for all measurements that may be required for the execution of the work to the location and limit marks prescribed in the specifications or on the contract drawings, subject to such modifications as the Contracting Officer may require to meet changed conditions or as a result of necessary modifications to the contract work.

(c) The Contractor shall furnish, at his own expense, such stakes, templates, platforms, equipment, tools and material, and all labor as may be required in laying out any part of the work from the base lines and benchmarks established by the Government. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other marks established by the Contracting Officer until authorized to remove them, and if such marks are destroyed, by the Contractor or through his negligence prior to their authorized removal they may be replaced by the Contracting Officer, at his discretion, and the expense of replacement will be deducted from any amounts due or to become due the Contractor. The Contracting Officer may require that work be suspended at any time when location and limit marks established by the Contractor are not reasonably adequate to permit checking of the work.

(d) Records of Contractor-performed survey activities shall be kept in complete, accurate, and legible field notes. The format shall conform to established standards for such records. Prior to any surveys, the Contractor shall submit the field note format for approval.

(e) The layout of work shall be under the direction of a competent survey party chief who has the following minimum qualifications: (1) high school graduate; (2) 7 years survey experience; (3) 4 years experience on

construction related survey activities, and (4) 1 year experience as survey party chief.

1.22 PLANTS AVAILABLE

Each bidder shall, upon request of the Contracting Officer, furnish a list of the plants available to the bidder and proposed for use on the work.

1.23 DAMAGE TO WORK (1966 MAR OCE)

The responsibility for damage to any part of the permanent work shall be as set forth in the CONTRACT CLAUSE titled "Permits and Responsibilities." However, if, in the judgment of the Contracting Officer, any part of the permanent work performed by the Contractor is damaged by flood or earthquake, which damage is not due to the failure of the Contractor to take reasonable precautions or to exercise sound engineering and construction practices in the conduct of the work, the Contractor will make the repairs as ordered by the Contracting Officer and full compensation for such repairs will be made at the applicable contract unit or lump sum prices as fixed and established in the contract. If, in the opinion of the Contracting Officer, there are no contract unit or lump sum prices applicable to any part of such work an equitable adjustment pursuant to CONTRACT CLAUSE titled, "Changes," of the contract, will be made as full compensation for the repairs of that part of the permanent work for which there are no applicable contract unit or lump sum prices. Except as herein provided, damage to all work (including temporary construction), utilities, materials, equipment and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

1.24 WORK ADJACENT TO ROADS AND HIGHWAYS

Where the construction work is on or adjacent to, or involves hauling over public or private roads, streets, or highways, all herein referred to as "roads," the said roads shall, except as otherwise specified or directed, be kept open for traffic at all times during the construction period. Further, the Contractor shall, during said construction, provide, erect and maintain warning signs, lanterns or torches or other safety devices and, when necessary, provide flagmen for protection of traffic to the satisfaction of the Contracting Officer and local authorities. The Contractor shall keep the right-of-way of the roads free of debris that might be caused to accumulate thereon by his operations, and upon completion of the work, shall clean up the said roads and repair any damage to the roads occasioned by his operations under this contract to the satisfaction of the Contracting Officer and local authorities having jurisdiction. The drainage from the roads shall not be obstructed by the construction work. The Contractor shall be responsible for obtaining and paying for all permits required for operation on all roads.

1.25 APPROVED EQUAL

The drawings and the TECHNICAL PROVISIONS of these specifications may, in some instances, refer to certain items of equipment, material, or article by trade name. References of this type shall not be construed as limiting competition, but shall be regarded as establishing a standard of quality. In this respect, the Contractor's attention is directed to CONTRACT CLAUSE titled "Material and Workmanship."

1.26 SCHEDULE OF WORK

The Contractor's attention is directed to CONTRACT CLAUSE titled "Schedule for Construction Contracts" and Specification Section SPECIAL SCHEDULING, wherein if, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer.

1.27 PROTECTION OF UTILITY LINES

(a) It shall be the Contractor's responsibility to protect all existing utility lines from damage during excavation for utilities systems and during all construction all activities. Any damage resulting to existing utility systems shall be repaired by the Contractor, to the satisfaction of the contracting officer, at no additional cost to the Government.

(b) All requests for access and/or locations must be made through the Contracting Officer's Representative (COR) or Resident Engineer. The Levee District will work directly with the Resident Engineer to provide timely information to the Contractor.

1.28 CLOSEOUT OF CONTRACTS (KCD JULY 1990)

This paragraph applies to all items not clearly identified in the specification for L385. All the mechanical, electrical, and flood protective structures which require operation and maintenance shall have applicable closeout materials and data listed below provided at time of closeout.

The Government shall hold ten percent of the total line item construction cost until all documents are received and approved. The Contractor shall allow thirty calender days for the review period of all closeout items. This includes all the items clearly identified in the specifications

The closing out of various features of the contract shall be done before or on the Government contract construction completion date. The Contractor's specific submittals and items required for closeout include, but are not limited to, Operation and Maintenance Manuals (O&M), training, spare parts, equipment list, guarantees, as-built shop drawings and contract drawings.

The Contractor shall review the contract documents and prepare a plan for closeout no later than 90 days after the notice to proceed date for approval by the Contracting Officer Representative (COR). The closeout plan shall also include the Specification Volume No., specification reference section and building name on each closeout item. A summary of the type of closeout information required for each of the items shall be prepared by the Contractor for the closeout plan. The closeout data base shall be updated as required by the Contracting Officer to ensure adequate tracking of the items noted.

The following is a general list of the various types of closeout materials and the data required for each. (* indicates data required on initial submittal)

(a) O&M Manuals:

Descriptions*, Specification Paragraph*, Date Due*, No. Copies Due*, Date Submit Action Code, Resubmit Date, Approved, Date to User

(b) Training Requirements:

Description*, Specification Paragraph*, Length Required*, Date Scheduled, Plan Submitted, Plan Approved, Date Training Held

(c) Spare Parts Required:

Description*, Specification Paragraph*, Quantity Required*, Date Turned Over to User

(d) Salvaged Material:

Description*, Specification-Plan Requirement*, Quantity*, Turn In Document Received

(e) Government-Furnished Equipment:

Description*, Specification-Plan Requirement*, GFCI-GFGI*, Number Required*, Date Equipment Data Required*, Date Equipment Required*, Turnover Document Provided

(f) Utilities Provided or Relocated by Others:

Description*, Relocate or Provide*, Specification-Plan Note*, Date Required*

1.29 MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS

The right is reserved, as the interest of the Government may require, to revise or amend the specifications or drawings or both prior to the date set for opening bids. Such revisions and amendments, if any, will be announced by an amendment or amendments to this Invitation for Bids. If the revisions and amendments are of a nature which requires material changes in quantities or prices bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the issuing officer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids. (KCD APR 84)

1.30 UNEXPECTED HAZARDOUS SUBSTANCES

In the event that suspected hazardous substances are revealed during construction activities, all such construction activities in the immediate area shall be immediately suspended. Hazardous substances for purposes of this specification only, shall be defined as CERCLA hazardous substances, infectious or radioactive wastes, asbestos or oil. The Contractor shall leave the materials undisturbed and shall immediately report the find to the Contracting Officer's Representative (COR) so that proper authorities can be notified. The Contractor shall not resume construction activities in the vicinity of the suspected hazardous substances until written clearance is received from the COR. Identification and removal of any such materials will be conducted in accordance with all Federal, state and local environmental laws and regulations according to the CONTRACT CLAUSE titled "Differing Site Conditions."

1.31 SURVEY MARKERS

Reference is made to CONTRACT CLAUSE titled "Permits and Responsibilities", Chapter 60 of the Missouri Revised Statutes 1969, and rules titled "Maintenance of the Original US Public Land Survey Corners" adopted by the

Division of Geology and Land Survey, Missouri Department of Natural Resources. The Contractor shall be responsible for removing and relocating survey markers. Relocation shall be performed by a professional registered Land Surveyor.

1.32 DEMOLITION

Disposal of demolition waste shall be in accordance with all applicable Federal, State and local regulations, including "Chapter 260, RSMO" of the "Missouri Department of Natural Resources."

1.33 EXCAVATION NOTIFICATION

Prior to any excavation on either public or private properties, Missouri law requires that you notify all owners and operators of underground facilities in your dig site. Missouri One Call System (MOCS) can help you comply with the law; "Chapter 319, RSMO" of the "Missouri Department of Natural Resources," by calling this one toll-free number 1-800-344-7483.

1.34 MISSOURI SALES AND USE TAX (JUL 1997)

In accordance with FAR Clause 52.229, notice is given that the contract price excludes the Missouri sales tax and compensating (use) tax on all sales of tangible personal property and materials purchased by the Contractor or subcontractors for the construction of projects, including repairing or remodeling facilities, for the United States. In accordance with Section 144.062, RSMo., the Contracting Officer will issue and furnish to the Contractor an exemption certificate (example copy appears at the end of this section) for this project with the Notice to Proceed. The Contractor and the subcontractors will use the exemption certificate for this project in the purchase of supplies, materials and furnishings for incorporation in the project. The Contractor and the subcontractors shall furnish a copy of such certificate to all suppliers/materialmen from whom such purchases are made, and the suppliers shall execute invoices covering the same bearing the number of such certificate. (KCD OC)

1.35 MATERIAL SOURCES

Riprap, bedding, and coarse aggregates for cast-in-place concrete meeting the requirements of these specifications can be produced from the approved sources listed below.

(1)Coarse aggregate for concrete and stone protection materials for riprap and bedding:

QUARRIES	COUNTY	STATE	APPROVED LEDGE
LaFarge (Menefee) - Dresden Quarry Sec. 23, T.46N, R22W Sedalia, MO 816-826-0328	Pettis	MO	Burlington LS
Fischer Quarries Sec 17, T46, R21 Hughesville, MO 660-829-5555, 800-352-1517	Pettis	MO	Burlington LS
Hilty Quarries - Snyder Quarry	St. Clair	MO	Burlington

Sec. 16, T39N, R25W Clinton, MO 816-855-8135			
Hilty Quarries - Tightwad Quarry Sec. 3 & 34, T41N, R24W Clinton, MO 816-855-8135	Benton	MO	Burlington
Hilty Quarries - Warsaw North Quarry Sec. 15, T41N, R23W Clinton, MO 816-855-8135	Benton	MO	Burlington
Hilty Quarries - Warsaw South Quarry Sec. 4 T39N, R22W Clinton, MO 816-855-8135	Benton	MO	Burlington
Ash Grove Aggregates - Wheatland Quarry Sec. 2, T37N, R23W Butler, MO 816-679-4128	Hickory	MO	Burlington
AgRock Quarries SW1/4 Sec. 20, T37N, R22W Wheatland, MO	Hickory	MO	Burlington
Franklin Quarry Sec 34, T53N, R20W	Saline	MO	Burlington
Malan Quarry (Milan) Sec 5, T52N, R21W	Saline	MO	Burlington
Howard Quarry Sec 5, T52N, R21W	Saline	MO	Burlington

(2) Stone protection materials for riprap and bedding:

QUARRIES	**COUNTY**	**STATE**	**APPROVED LEDGE**
Damon Pursell Rock Ridge Quarry SW1/4 Sec 23 & NW1/4 Sec 26 T48N, R33W Liberty, MO 816-792-1031, 816-926-0300	Jackson	MO	Winterset LS and lower 17' Bethany Falls LS
APAC-Limpus Quarries (Metro/City Wide) Sec. 24, T50N, R32W Sugar Creek, MO 816-380-5170, 816-257-2222	Jackson	MO	lower 16 feet of Bethany Falls LS and lower 17' Winterset LS
Hunt Midwest Mining - Randolf Quarry SW1/4 Sec. 2, T50N, R32W Kansas City, MO 816-455-3876	Clay	MO	upper 13.6 feet Winterset LS and lower 16 feet Bethany Falls LS
Missouri Rock, Inc - Orrick Quarry	Ray	MO	Lower 8 feet of Bethany Falls LS and

NW1/4 Sec. 14, T51N, R29W		lower 8 feet of
Independence, MO	816-781-6459	Winterset LS

Listing of a source is not to be construed as approval of all material from the source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels when such materials are unsuitable as determined by the Contracting Officer. A winter quarrying prohibition is in effect for this contract. Riprap and bedding material production for this contract shall not be permitted from November 15 to March 21.

Materials may be furnished from any of the above listed sources or at the option of the Contractor may be furnished from any other source designated by the Contractor and approved by the Contracting Officer, subject to the conditions stated below.

After the award of contract, the Contractor shall designate in writing only one source or combination of sources from which he proposes to furnish each material. If the Contractor proposes to furnish material from a source or from sources not listed above, he may designate only a single source or single combination of sources for the material for testing by and at the expense of the Government. If a source of material so designated by the Contractor is not approved for use by the Contracting Officer, the Contractor may not submit for approval other sources but shall furnish the material from an approved source listed above at no additional cost to the Government. . The Contractor will be entitled to no additional compensation or extension of time due to any requirements for sampling and testing.

When the Contractor desires to use aggregates from a source not listed, suitable samples for quality evaluation consisting of not less than 1500 pounds of each size coarse aggregate shall be taken under the supervision of the Contracting Officer in accordance with CRD-C 100. These samples shall be delivered to an approved laboratory selected by the Government within 15 days after notice to proceed. Sampling and shipping of samples shall be at the expense of the Contractor. A minimum of 90 days will be required to complete evaluation of the proposed aggregates.

When the Contractor proposes to furnish riprap, or bedding from a source not listed, the Government will make such tests and other investigations as necessary to determine whether or not the rock materials meeting the requirements of this project can be produced from the proposed sources. The tests to which the rock materials may be subjected include specific gravity, absorption, Los Angeles abrasion, soundness in magnesium sulfate, petrographic analysis, freezing and thawing, alkali or carbonate-aggregate reaction, and organic impurities. Other tests may be performed as are necessary to demonstrate that rock products or concrete of acceptable quality can be produced from the proposed materials.

Approximately one sample per 1-1/2 feet of face and from each bed 8 inches or greater in the entire vertical face of the ledge to be quarried shall be taken by the Contractor in the presence of a Government representative. The samples shall be approximately 8- to 14-inch cubes and shall be marked in order, starting with number one at the top of the quarry face. Samples shall be delivered to a laboratory selected by the Government, 60 days in advance of the time the materials will be needed in the work. These samples will be subjected to freezing and thawing tests under Corps of Engineers specification CRD C-144 and to the specific gravity and absorption tests under Corps of Engineers specification CRD C-107. Since

the performance of these samples in the test will be affected by the presence of moisture, the extent of "drying out" and the amount of incipient fractures in the rock due to blasting shock, every effort shall b made to obtain samples for a quarry face that are truly representative of actual job production. At least 60 percent of the quarry face as represented by individual samples shall show individual losses of less than 25 percent, and the average loss of all samples shall be less than 25 percent.

The geologic rock unit of other sources submitted for stone protection shall have, as a minimum, a suitable 5 year service record on similar sized slope protection material exposed to shoreline conditions in a similar climatic region. The Contracting Officer will determine what is suitable for an adequate service record. Service record documentation shall include date used, where used, identification of ledges used, names of previous users, gradation produced, quantities produced since last tested, and result of most recent tests identified hereinafter. In addition to an acceptable 5-year service record, as determined by the Contracting Officer, the Contracting Officer has the option to elect to have representative samples taken and tested.

1.36 UNIT LUMP SUM AND UNIT PRICING

The bid schedule unit or lump sum pricing and measurement units given as bid items on the bid schedule shall be used for Construction Administration. Payments or Modifications to the Construction Contract will be based on the appropriate bid schedule item. The unit or lump sum pricing and measurement units, if any, found in the specifications are for Construction Administrative use to insure proper standards.

The Contractor shall provide an electronic measurement and payment schedule based on the bid schedule items. The schedule shall provide a work breakdown structure using both detail feature codes and descriptions using ASTM El 557-97 UNIFORMAT II. The work breakdown structure shall cover all the items of a task and cost which are put together as one element in a project. The Contractor will be required to provide a copy of the software used by the Contractor for measurement and payment billing to the COR. The Contractor's program shall also provide Cost Accounting Reports. Reports shall include labor hours and cost, material cost, equipment cost and total cost. All items must be Fair Market Price. Fair Market Price is a method of estimating a task by labor, materials and equipment using a minimum of three cost surveys by the Contractor if it is identified as an unbalanced cost by the COR. The fair market price must be tempered by judgmentally incorporating particular job conditions. Also a cost is reasonable if, in its nature and amount, it does not exceed that which would be incurred by a prudent person well equipped in the conduct of competitive business. The COR shall establish what is reasonable using the United States Army Corps of Engineers estimating program called Micro Computer-Aided Cost Estimating Systems (MCACES). MCACES is used for the preparation of detailed construction cost estimates.

1.37 SPECIFICATIONS OF PHASE I AND II.

If there is a difference in the specifications between Phase 1 and 2, the more stringent requirement between the specification will apply. This will only be implemented by the COR if a ruling or judgement must be made.

1.38 COORDINATION BETWEEN CONTRACTORS

Construction work on the Argosy bump-out portion of Phase II will be performed by separate, private contract concurrent with the work required by this Solicitation. The Argosy contractor will construct a portion of the I-wall as noted on the plans and in the specifications for this Solicitation. The obligations of the successful bidder for this Solicitation will include planning and scheduling the work on a cooperative basis with the other contractor involved in order to minimize delays and interferences.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

* * * * * *

EXAMPLE

STATE OF MISSOURI

PROJECT EXEMPTION CERTIFICATE FOR EXEMPT ENTITY CONSTRUCTION

UNITED STATES OF AMERICA

NAME OF EXEMPT ENTITY

ADDRESS

CITY STATE ZIP

TAX IDENTIFICATION NUMBER (None required)

PROJECT IDENTIFICATION NUMBER

PLEASE PROVIDE THE PROJECT LOCATION AND A BRIEF DESCRIPTION BELOW:

CONTRACT DATE

CERTIFICATE EXPIRATION DATE

Contractors are required to provide a copy of this project exemption certificate to their vendors.

This project exemption certificate does not allow contractors to purchase machinery, equipment, or tools used in fulfilling this contract, tax exempt.

Suppliers accepting this project exemption certificate are required to render to the contractor invoices bearing the name of the exempt entity and the project identification number.

An exempt entity that fails to revise the expiration date on this certificate as necessary to complete any work required by the contract will be liable for any sales tax determined due as a result of an audit of the contractor.

The Contractor shall provide this project exemption to all subcontractors purchasing construction materials for this project.

SIGNATURE OF AUTHORIZED AGENT

EXHIBIT A

-- End of Section --

SECTION 01312A

QUALITY CONTROL SYSTEM (QCS)
08/01

1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320A, PROJECT SCHEDULE, Section 01330, SUBMITTAL PROCEDURES, and Section 01451A, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request

by the Contractor, the Government can provide QCS on 3-1/2 inch high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

Hardware

IBM-compatible PC with 200 MHz Pentium or higher processor

32+ MB RAM

4 GB hard drive disk space for sole use by the QCS system

3 1/2 inch high-density floppy drive

Compact disk (CD) Reader

Color monitor

Laser printer compatible with HP LaserJet III or better, with minimum 4 MB installed memory.

Connection to the Internet, minimum 28 BPS

Software

MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended)

Word Processing software compatible with MS Word 97 or newer

Internet browser

The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract.

Electronic mail (E-mail) compatible with MS Outlook

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM). The QCS database typically shall include current data on the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.6.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.6.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered

starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 Finances

1.6.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01451A, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01451A, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the Government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

1.6.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS.

The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.6.4 Submittal Management

The Government will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320A, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320A PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

1.8.1 File Medium

The Contractor shall submit required data on 3-1/2 inch double-sided

high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.8.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.8.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

-- End of Section --

SECTION 01320A

PROJECT SCHEDULE
08/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referenced in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11	(1995) Progress, Schedules, and Network Analysis Systems

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel will result in an inability of the Contracting Officer to evaluate Contractor's progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have

been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule:

3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations are greater than 20 days).

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.3.2.3 Critical Activities

The following activities shall be listed as separate line activities on the Contractor's project schedule:

a. Submission and approval of mechanical/electrical layout drawings.

b. Submission and approval of O & M manuals.

c. Submission and approval of as-built drawings.

d. Submission and approval of 1354 data and installed equipment lists.

e. Submission and approval of testing and air balance (TAB).

f. Submission of TAB specialist design review report.

g. Submission and approval of fire protection specialist.

h. Submission and approval of testing and balancing of HVAC plus commissioning plans and data.

i. Air and water balance dates.

j. HVAC commissioning dates.

k. Controls testing plan.

l. Controls testing.

m. Performance Verification testing.

n. Other systems testing, if required.

o. Prefinal inspection.

p. Correction of punchlist from prefinal inspection.

q. Final inspection.

3.3.2.4 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.5 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.6 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.7 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.3.2.8 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.9 Phase of Work

All activities shall be identified in the project schedule by the phases of work in which the activity occurs. Activities shall not contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.10 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.11 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to, a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.3 Scheduled Project Completion

The schedule interval shall extend from NTP to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the

contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted in the narrative report at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure

that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Program features which calculate one of these parameters from the other shall be disabled.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contractor shall propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule.

3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after the NTP is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after NTP.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after NTP. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used.

3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the preliminary submission, initial submission, and every periodic project schedule update throughout the life of the project:

3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks shall adhere to the SDEF format specified in ER 1-1-11, Appendix A.

3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, under the MS-DOS Version 5. or 6.x, unless otherwise approved by the Contracting Officer.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Preliminary, Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the MS-DOS version used to format the disk.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with the preliminary, initial, and each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number. Preceeding and succeeding activities shall include all information listed above in paragraph Schedule Reports. A blank line shall be left between each activity grouping.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the NTP until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the

sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates,

Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. As a minimum, the Contractor shall address the following items on an activity by activity basis during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed .

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations shall be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule which does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed

revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES
09/01

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION (SD)

Submittals required are identified by SD numbers and titles as follows:

SD-01 Data

SD-04 Drawings

SD-06 Instructions

SD-07 Schedules

SD-08 Statements

SD-09 Reports

SD-13 Certificates

SD-14 Samples

SD-18 Records

SD-19 Operation and Maintenance Manuals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. **Caution:** The Contractor is cautioned that for each Contractor's resubmittal required beyond the initial submittal and one resubmittal for corrections required by the Contracting Officer, the Contracting Officer will assess Administrative Deduction in the amount of $500.00 from the progress payments due the Contractor. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials will not be made if required approvals have not been obtained.

1.6 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in

compliance with existing laws and regulations.

1.7 SUBMITTAL REGISTER

At the end of this section is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. The Contractor shall maintain a submittal register for the project in accordance with Section 01312A QUALITY CONTROL SYSTEM (QCS).

1.8 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

1.9 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

1.10 SUBMITTAL PROCEDURES

Submittals shall be made as follows:

1.10.1 Procedures

<u>One complete set of all submittals shall go to the Resident Engineer.</u>

The Contractor shall submit for approval five (5) copies of all submittals. Items not to be submitted in quintuplicate, such as samples and test cylinders, shall be submitted accompanied by five (5) copies of ENG Form 4025. Items to be sent to EC-DS or EC-GL shall be addressed as follows:

US Army Engineer District, Kansas City
Federal Building, 601 East 12th Street, EC-DS
Kansas City, Missouri 64106-2896

AE designs:

- The AE will review submittals requiring an engineering review for designs they completed. Submittals designated for the resident engineer's

(Construction) office will not go to the AE even though the AE completed the design.

- To track and expedite, submittals with an AE designation will go directly to the AE with a copy of the transmittal cover (only) to EC-DS for login. AE responses/actions go directly to the Resident Engineer's office with a copy to EC-DS for tracking.

Other District Designs:

- Submittals designated for Resident Engineer will go to the Resident Engineer only. To track and expedite, submittals with an other District Designs designation will go directly to the District with a copy of the transmittal cover (only) to EC-DS for login. Other District design responses/actions go directly to the Resident Engineer's office with a copy to EC-DS for tracking.

KCD Designs:

- Submittals designated for Resident Engineer will go to the Resident Engineer only. Submittals with an engineering review, will go to KCD through EC-DS for login and distribution to the reviewers.

1.10.2 Deviations

For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.11 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.12 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four (4) copies of the submittal will be retained by the Contracting Officer and one copy of the submittal will be returned to the Contractor.

1.13 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring

removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.14 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR
(Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attached sheets(s).
SIGNATURE: _____
TITLE: _____
DATE: _____

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE

(Read instructions on the reverse side prior to initiating this form)

DATE

TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:

FROM:

CONTRACT NO.

CHECK ONE:

☐ THIS IS A NEW TRANSMITTAL

☐ THIS IS A RESUBMITTAL OF TRANSMITTAL

SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*

PROJECT TITLE AND LOCATION

CHECK ONE: THIS TRANSMITTAL IS FOR

FIO ☐ GOV'T. APPROVAL ☐

ITEM NO. *a.*	DESCRIPTION OF ITEM SUBMITTED *(Type size, model number/etc.)* .	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. *(See instruction no. 8) c.*	NO. OF COPIES *d.*	CONTRACT REFERENCE DOCUMENT SPEC. PARA. NO. *e.*	CONTRACT REFERENCE DOCUMENT DRAWING SHEET NO. *f.*	FOR CONTRACTOR USE CODE *g.*	VARIATION *(See instruction No. 6)* .	FOR CE USE CODE *i.*

REMARKS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated.

NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*

NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY

DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.

4. Submittals requiring expeditious handling will be submitted on a separate form.

5. Separate transmittal form will be used for submittals under separate sections of the specifications.

6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.

9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A -- Approved as submitted.

B -- Approved, except as noted on drawings.

C -- Approved, except as noted on drawings. Refer to attached sheet resubmission required.

D -- Will be returned by separate correspondence.

E -- Disapproved (See attached).

F -- Receipt acknowledged.

FX -- Receipt acknowledged, does not comply as noted with contract requirements.

G -- Other *(Specify)*

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
01100

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Accident Prevention Plan					X							X	RE									
			1.4	Equipment Lists					X							X	RE									
			1.4	Guarantees					X							X	RE									
			1.4	Warranty Service Call Plan					X							X	SD									
			1.4	As-Built Drawings and CADD Files					X							X	RE									
			1.4	Shop Drawings					X							X	RE									
			1.4	Electrical Distribution System					X							X	RE									
			1.4	Operations and Maintenance										X		X	RE									
				Drawings																						

ENG FORM 4288, Jul 96 SPECSINTACT PAGE 1 OF 1 PAGES

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
01355

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.7	Environmental Protection Plan	X											X	RE										

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
01780A

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2.1	As-Built Drawings												X	RE									
			1.2.2	As-Built Record of Equipment and												X	RE									
				Materials																						
			1.3.1	Warranty Management Plan												X	RE									
			1.1	Warranty Tags												X	RE									
			1.1	Final Cleaning												X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
01800

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Contingency Plan	X											X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02101

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Plans of Operations	X											X	GA									

ENG FORM 4288, Jul 96

SPECSINTACT

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02102**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Plan of Operations	X											X	RE									
			1.2	Disposal Plan(s)	X											X	RE									
			1.2	Disposition	X											X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02103

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.1.1.1	Category 1 Utility Relocations	X											X	RE									
			1.1.1.2	Category 2 - Utility Relocations	X											X	RE									
			1.1.1.3	Category 3 - Utility Relocations	X											X	RE									
			1.4	Construction Design	X											X	RE									
			1.5	General Contract	X											X	RE									
			1.6	Less cost of betterments	X											X	RE									
			1.12	Performance of Engineering Services	X											X	RE									
			1.9	Utilities general design	X											X	RE									
			1.10	For Utilities locations and plans	X											X	RE									
			1.11	Approvals of Relocations Design	X											X	RE									
				Memoranda																						
			1.5	Release	X											X	RE									

ENG FORM 4288, Jul 96

SPECSINTACT

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02104

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.16	35 percent Submittal	X											X	CG									
			1.16	95 percent Submittal	X											X	CG									
			1.16	Final Submittal	X											X	CG									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02160**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Layout, Design Drawings, and	X											X	RE									
				Calculations																						

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02170

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Designs	X											X	EC									
			1.3	Plan of Operations					X							X	EC									
			1.3	Architecture-Engineer Qualifications					X							X	EC									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02200**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Drilling Fluid Additives	X										X	EC										
			1.3	Drilling Fluid Loss	X										X	EC										
			1.3	Drilling Fluid Pit Methods	X										X	EC										
			1.3	Flow Rate Measurement Design	X										X	EC										
			1.3	Discharge Sand Sampler	X										X	EC										
			1.3	Grout Accelerators	X										X	EC										
			1.3	Drilling Fluid Pit Systems		X									X	EC										
			1.3	Centering Devices		X									X	EC										
			1.3	Surge Block		X									X	EC										
			1.3	Jetting Tool		X									X	EC										
			1.3	Airlift Equipment		X									X	EC										
			1.3	Welder Qualifications					X						X	EC										
			1.3	Well Driller Qualifications					X						X	EC										
			1.3	Sterilization Data					X						X	EC										
			1.3	Particle Size Distribution - Primary						X					X	EC										
				Medium Filter Pack																						
			1.3	Particle Size Distribution - Primary						X					X	EC										
				Coarse Filter Pack																						
			1.3	Particle Size Distribution - Secondary						X					X	EC										
				Filter Pack																						
			1.3	Well Reports and Logs						X				X												
			1.3	Riser Pipe Compliance							X			X												
			1.3	Well Screen Compliance							X			X												

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02220

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Work Plan	X											X	RE									

ENG FORM 4288, Jul 96

SPECSINTACT

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02228**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Plan of Operations	X											X	RE									
			1.2	Aggregate Sources					X						X											
			1.2	Test Methods					X							X	EC									
			1.2	Field Test Reports						X						X	EC									
			1.2	Survey Data						X					X											
			1.2	Weigh Bills						X					X											

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02251

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Grouting Equipment; GA-RE.	X																					
			1.2	Materials; GA-RE.	X																					
			1.2	Operations; GA-RE.	X																					
			1.2	Grout Mix Test Results; GA-RE.	X																					
			1.2	Chemical Grouting Work Plan;					X																	
				GA-RE.																						
			1.2	Qualifications; GA-RE.					X																	

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02316

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			3.5.3	Field Density Tests						X					X											
			3.5.2	Testing of Backfill Materials						X						X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02318

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Installation Methods and Procedures	X										X												
			1.3	Grouting Specialist Qualifications	X										X												
			1.3	Mixture Proportioning	X											X	RE										
			1.3	Curing and Protection	X											X	RE										
			1.3	Cold-Weather Placing	X										X												
			1.3	Hot-Weather Placing	X										X												
			1.3	Quality and Gradation of Aggregates						X						X	RE										
			1.3	Tests and Inspections						X						X	RE										
			1.3	Cementitious Materials							X					X	RE										
			1.3	Air-Entraining Admixture							X					X	RE										
			1.3	Other Chemical Admixtures							X					X	RE										
			1.3	Nonshrink Grout							X					X	RE										
			1.3	Aggregates							X					X	RE										
			1.3	Non-structural flowable backfill							X					X	RE										

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02331**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Shoring, Sheeting, and Bracing					X							X										
			1.3	Excavation					X							X										
			1.3	Borrow Areas					X							X										
			1.3	Plan of Operations					X							X										
			1.3	Testing Laboratory					X							X										
			1.3	Embankment and Backfill Materials					X							X										
			1.3	Nuclear Density Testing Equipment					X							X										
				Operator																						
			1.3	Survey Records						X						X										
			1.3	Test Results									X			X										
			1.3	Inspection and Test Results							X					X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02370

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			3.2.2	Layout		X										X	EC									
			1.4	Erosion Control Details		X										X	EC									
			3.2.4	Obstructions Below Ground		X																				
			1.4	RE		X																				
			1.4	Synthetic Sheet Systems	X											X	EC									
			1.4	Equipment	X																					
			1.4	RE	X																					
			1.4	Materials								X				X	RE									
			2.1	Synthetic Sheet System						X						X	RE									
			1.4	Topsoil							X					X	RE									
			1.4	Construction Work Sequence							X					X	EC									
			1.7	Installer's Qualification							X					X	RE									
			3.6	Maintenance Record										X												
			1.4	RE										X												
			3.6.1.1	Maintenance Instructions										X												

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02371

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.1.1	Gabions							X					X	GL									
			2.1.2	Alternative Wire Fasteners for							X					X	GL									
				Gabions																						
			1.3	Pier Protection Plan							X					X	GL									
			2.1.3	Stone Fill								X				X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02378**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.1.1.1	Geotextile							X				X											
			2.1.1.1	Geotextile								X			X											

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02380**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.2.3	Riprap;	X											X	EC									
			2.1	Bedding Material	X											X	EC									
			2.2.1.1	Gradation Test						X						X	RE									
			1.4	Stone							X				X											
			2.1	Bedding Material							X				X											
			1.4	Laboratory							X					X	RE									
			1.4	Weigh Scale Certification							X				X											
			1.4	Certified Weight Scale Tickets							X				X											

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02431**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			3.6.1	Equipment	X											X										
			1.3	Controlled Low Strength Material	X											X										
			1.3	Concrete Pipe and Pipe Jacking	X											X										
				Construction																						
			1.3	Concrete Pipe and Pipe Jacking		X										X										
				Construction																						
			3.8	Tests						X						X										
			1.3	Qualifications							X					X	G									
			1.3	Grouting Equipment							X					X	RE									
			1.3	Grout Application							X					X	RE									
			1.3	Concrete Pipe and Pipe Jacking							X					X										
				Construction																						
			1.3	Samples of Impervious Stratum							X					X										
			3.8	Tests							X					X										
			1.3	controlled low strength material						X						X										
			3.8	Tests						X						X										
			3.4	Drilling Operations						X						X										
			3.4	Pressure Washing and Pressure						X						X										
				Testing Operations																						
			3.4	Cement and controlled low strength						X						X										
				material Grouting Operations																						
			1.3	Portland Cement							X					X	RE									
			2.3	Joints							X					X	RE									
			1.3	Backfill							X															
			1.3	RE							X															
			1.3	Concrete Pipe and Pipe Jacking							X					X										
				Specialist																						

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02456

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Pile Driving Equipment	X											X	GL									
			1.4	Pile Testing Subcontractor	X											X	EC									
			1.4	Pile Driving Records	X											X	RE									
			1.4	Delivery, Storage and Handling	X											X	GL									
			1.4	Pile Tests	X											X	GL									
			2.1	MATERIALS	X											X	GL									
			1.4	Pile Splices		X										X	EC.									
			1.4	Pile Placement		X										X	GL									
			1.4	Mill Inspection						X						X	EC									
			1.4	Pile Driving Tests						X						X	GL.									
			1.4	Pile Driving Analyzer						X						X	GL									
			1.4	Pile Load Tests						X						X	GL									
			1.4	Pile Driving Records									X			X	GL									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02457

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Pile Driving Equipment	X											X	GL									
			1.4	Pile Testing Subcontractor	X											X	EC									
			1.4	Pile Driving Records	X											X	RE									
			1.4	Delivery, Storage and Handling	X											X	GL									
			1.4	Pile Tests	X											X	GL									
			1.4	Pile Splices		X										X	EC									
			1.4	Pile Placement		X										X	GL									
			1.4	Field Tests and Inspections						X					X											
			2.1	Materials							X					X	GL									
			1.4	Mill Inspection							X					X	EC									
			1.4	Pile Driving Tests							X															
			1.4	Pile Driving Analyzer							X					X	GL									
			1.4	Pile Load Tests							X					X	GL									
			1.4	Pile Driving Records									X			X	GL									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02464**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.1	Layout, Design Drawings, and	X											X	RE									
				Calculations																						
			2.1	Metal Sheet Piling		X										X	RE									
			2.1	Metal Sheet Piling		X										X	RE									
			2.1	APPURTENANT METAL		X										X	RE									
				MATERIALS																						
			3.1.1	Pile Driving Equipment				X								X	RE									
			3.1.5	Pulling and Redriving					X							X	RE									
			2.3.1	Materials Tests					X						X											
			2.1	Welder Qualifications							X					X	RE									
			3.1.2.2	Driving									X		X											

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02465**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.7	Grout Pump	X											X										
			2.1	Materials	X											X										
			1.2	Equipment	X											X	RE									
			1.2	Piling Equipment	X											X	GL.									
			1.2	Grout Piling		X										X										
			1.2	Grout Piling					X							X	RE									
			1.2	Plan of Operations					X							X	GL									
			3.6	Grout specimens for Contractor						X						X	RE									
				Tests																						
			3.7	TEST PILES						X						X	RE									
			3.5	Grout Specimens for Laboratory								X				X	RE									
				Tests																						
			1.2	Quality Control									X			X										

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02466**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Caissons							X					X	RE									
			1.4	Qualifications							X					X	GL									
			1.3	Plan of Operation					X							X	GL									
			1.3	Drilled Pier Site Explorations									X			X	G									
			1.3	Drilled Foundation Caissons									X			X	GL									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02510

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			3.1	Installation			X																			
			1.3	Product Literature;			X																			
			2.6.3	Meters							X					X	RE									
			1.3	Waste Water Disposal Method					X																	
			3.3	Bacteriological Disinfection						X																

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02531**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Portland Cement							X					X	RE									
			2.3	Joints							X															

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02630**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			3.3	Placing Pipe			X									X	RE									
			1.2	Pipe Testing							X					X	RE									
			3.8	Pipeline Testing							X					X	RE									
			3.9	Pipeline Testing							X					X	RE									
			2.9	Hydrostatic Test on Watertight Joints							X					X	RE									
			3.7.5	Determination of Density							X					X	RE									
			2.3.4	Frame and Cover for Gratings							X					X	RE									
			1.2	Pipe for Culverts and Storm Drains								X				X	RE									
			2.1.1	Choice of Piping								X				X	RE									
			2.5	JOINTS								X				X	RE									
			2.1.2.2	Ductile Iron Culvert Pipe								X				X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02700

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Testing Laboratory					X							X	RE									
			1.2	Equipment					X							X	KC									
			1.2	Mixing Plant					X							X	KC									
			1.2	Composition of Mixture						X						X	KC									
			1.2	Coarse Aggregate						X						X	KC									
			1.2	Fine Aggregate						X						X	KC									
			1.2	Mineral Filler						X						X	KC									
			1.2	Aggregate Gradation						X						X	KC									
			1.2	Crushed Particle Test						X						X	KC									
			1.2	Specific Gravity Test						X						X	KC									
			1.2	Bituminous Material							X					X	KC									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02721**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.6	Equipment	X										X											
			1.3	Material Source					X							X	RE									
			1.4	Sampling and Testing						X						X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02722**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Equipment	X										X											
			1.3	Material Source					X							X	KC									
			1.5	Sampling and Testing						X						X	GA									
			1.5	Sampling and Testing						X						X	GA									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02731**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Equipment	X										X											
			1.5	Sampling and Testing						X						X										
			3.9	DENSITY TESTS						X						X										
			1.3	weight certificates						X						X										

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02748

ACTIVITY NO. a.	TRANS-MITTAL NO. b.	ITEM NO. c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Tests						X						X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02754

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.7	Equipment	X																					
			3.4	Paving				X																		
			2.11	Mixture Proportions					X							X										

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02760

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Manufacturer's Recommendations			X								X											
			1.2	Construction Equipment List				X							X											
			1.2	Sealant and Back-up Materials							X					X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02763

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Equipment Lists	X											X	RE									
			1.2	Mixing, Thinning and Application			X								X											
			1.2	Volatile Organic Compound (VOC)							X				X											
				Content																						
			1.2	Paint certification							X				X											

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02821

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Chain Link Fence							X					X	RE									

ENG FORM 4288, Jul 96

SPECSINTACT

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **02840**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Vehicle Barriers and Construction	X											X	RE									
				Signs																						
			1.3	Equipment Lists	X											X	RE									
			1.3	Vehicle Barriers and Construction		X										X	RE									
				Signs																						
			1.3	Vehicle Barriers and Construction					X							X	RE									
				Signs																						
			1.3	Testing Data						X						X	RE									
			3.13	CONSTRUCTION SIGNS							X															
				CERTIFICATION																						
			1.3	Vehicle Barriers and Construction										X		X	RE									
				Signs																						

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02921

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Equipment	X											X	RE									
			2.7	Surface Erosion Control Material	X											X	RE									
			1.2	Chemical Treatment Material	X											X	RE									
			1.2	Equipment				X								X	RE									
			1.4.1	Delivery					X							X	RE									
			3.2.1	Finished Grade and Topsoil					X							X	RE									
			2.2	Topsoil					X							X	RE									
			3.1.3	Equipment Calibration						X						X	RE									
			1.2	Soil Test						X						X	RE									
			2.1	Seed							X					X	RE									
			2.2	Topsoil							X					X	RE									
			2.3.1	pH Adjuster							X					X	RE									
			2.3.2	Fertilizer							X					X	RE									
			2.3.3	Organic Material							X					X	RE									
			2.3.4	Soil Conditioner							X					X	RE									
			1.2	Wood Fiber Mulch/Tackifier							X					X	GA									
			2.6	Pesticide							X					X	RE									
			1.2	Leguminous Inoculant							X					X	RE									
			1.4.1.1	Delivered Topsoil								X				X	RE									
			2.3	Soil Amendments								X				X	RE									
			1.2	Wood Fiber Mulch/Tackifier								X				X	RE									
			3.5	Quantity Check									X			X	RE									
			3.9	Seed Establishment Period									X			X	PM-									
			3.9.3.3	Maintenance Record									X			X	RE									
			3.6	Application of Pesticide									X			X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
02990

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL										CLASSI-FICATION		REVIEWER r.	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS aa.
					DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	INFORMATION ONLY p.	GOVERNMENT APPROVED q.		SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	CODE y.	DATE z.	
			1.4	Plan of Operations		X										X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **03101**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.1	Materials	X										X											
			1.4	Shop Drawings		X									X											
			1.4	Shop Drawings					X						X											
			3.3	Inspection						X					X											
			3.2.1	Formwork Not Supporting the Weight						X						X	RE									
				of Concrete																						

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SPECSINTACT

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **03150**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.1	Preformed Expansion Joint Filler	X											X	RE									
			2.3	Sealant	X											X	RE									
			2.4	Waterstops	X											X	RE									
			2.4	Waterstops		X										X	RE									
			2.1	Preformed Expansion Joint Filler			X									X	RE									
			2.3	Sealant			X									X	RE									
			2.4	Waterstops			X									X	RE									
			2.1	Preformed Expansion Joint Filler							X					X	RE									
			2.3	Sealant							X					X	RE									
			2.4	Waterstops							X					X	RE									
			1.2	Preformed Compression Seals and								X				X	RE									
				Lubricants																						
			2.3.3	Field-Molded Type								X				X	RE									
			2.4.2	Non-metallic Materials								X				X	RE									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
03200

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Concrete Reinforcement System		X										X	RE									
			2.3	Reinforcing Steel							X				X											

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
03301

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.2	Concrete Mixture Proportioning					X							X	EC									
			3.1.2	Batch Plant					X							X	EC									
			3.1.3	Concrete Mixers					X							X	EC									
			3.1.1	Capacity					X							X	RE									
			3.1.4	Conveying Equipment					X						X											
			3.1.1	Placing Equipment					X						X											
			3.7.1	Testing Technicians					X						X											
			3.7.1	Concrete Transportation Construction					X						X											
				Inspector (CTCI)																						
			3.2.4	Construction Joint Treatment					X							X	EC									
			3.5	Curing and Protection					X							X	EC									
			1.3	Cold-Weather Placing					X							X	EC									
			1.3	Hot-Weather Placing					X							X	EC									
			1.3	Aggregate Quality						X						X	EC									
			1.3	Uniformity of Concrete Mixing						X						X	EC									
			3.7	Tests and Inspections						X						X	EC									
			2.1.1	Cementitious Materials							X					X	EC									
			2.1.4.1	Impervious-Sheet Curing Materials							X					X	EC									
			2.1.3.1	Air-Entraining Admixture							X					X	EC									
			2.1.3.4	Other Chemical Admixtures							X					X	EC									
			2.1.4.2	Membrane-Forming Curing							X					X	EC									
				Compound																						
			2.1.7	Epoxy Resin							X					X	EC									
			2.1.6	Nonshrink Grout							X					X	EC									
			1.4.1.1	Aggregates								X				X	EC									

SUBMITTAL REGISTER
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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **03330**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.2	Concrete Mixture Proportioning	X											X	GL									
			2.2	MIXTURE PROPORTIONING	X											X	GL									
			1.2	Batch Plant	X											X	GL									
			1.2	Concrete Mixers	X											X	GL									
			1.2	Capacity	X											X	GL									
			1.2	Conveying Equipment	X											X	GL									
			1.2	Placing Equipment	X											X	GL									
			1.2	Tests and Inspections	X											X	GL									
			1.2	Testing Technicians	X											X	GL									
			1.2	Concrete Transportation Construction	X											X	GL									
				Inspector (CTCI)																						
			1.2	Construction Joint Treatment	X											X	GL									
			1.2	Curing and Protection	X											X	GL									
			1.2	Cold-Weather Placing	X											X	GL									
			1.2	Hot-Weather Placing	X											X	GL									
			1.2	Finishing	X											X	GL									
			1.2	Aggregates								X				X	GL									
			1.2	Cementitious Materials, Admixtures,								X				X	GL									
				and Curing Compound																						
			2.1.1	Color Admixture								X				X	GL									
			2.1.5	Surface Sealer								X				X	GL									
			2.1.6	Form Release Agents								X				X	GL									
			2.1.7	Material quality control								X				X	GL									
			2.1.8	Patching material Samples								X				X	GL									
			1.2	Quality of Aggregates						X						X	GL									
			1.2	Mixer Uniformity						X						X	GL									
			1.2	Tests and Inspections						X						X	GL									
			2.3.4	Time standards						X						X	GL									
			2.3.3.2	The slump of the concrete						X						X	GL									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **03330**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			2.3.3.1	Moisture Test						X						X	GL									
			2.3.3	Moisture Control						X						X	GL									
			2.1.2.1	Membrane-Forming Curing							X					X	GL									
				Compound																						
			1.2	Fibreglass Form Ties							X					X	GL									
			2.1.5	Surface Sealer							X					X	GL									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
03416

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			3.8	Erection		X										X	AE									
			3.8.4	Erection Plan	X											X	RE									
			1.3.1.3	Design Calculations	X											X	AE									
			2.2	Concrete Mixture Proportions	X											X	RE									
			3.9	Construction Records	X																					
			1.2	RE	X																					
			2.1	Materials						X																
			1.2	RE						X																
			1.3.2.1	Concrete						X																
			2.1.1	Cement							X															
			1.2	RE,							X															
			2.1.2	Pozzolan							X															
			2.1.3.2	Air-Entraining Admixture							X															
			2.1.3.2	Water-Reducing Admixture							X															
			2.1.3.2	Accelerating Admixture							X															
			2.1.3.1	Aggregates							X															
			1.3.2.2	Air Content							X															
			1.2	RE							X															

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CONTRACT NO.
DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
05055

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Lists of Materials	X											X	RE									
			1.6	Detail Drawings		X										X	RE									
			1.4	Shop Drawings		X										X	RE									
			2.5.9	Recess Frames		X										X	RE									
			2.1.1	Materials Orders				X							X											
			2.1.2	Materials List				X							X											
			2.1.3	Shipping Bill				X							X											
			2.4.2.2	Welding Procedures for Structural					X							X	RE									
				Steel																						
			2.4.2.4	Welding of Aluminum					X							X	RE									
			2.5.5	Structural Steel Welding Repairs					X							X	RE									
			1.4	Manufacturer Design Calculations					X						X											
			2.5	Tests, Inspections, and Verifications						X					X											
			1.4	Test Reports for Fracture Critical						X						X	RE.									
				Members (FCM)																						
			1.7	Qualification of Welders and Welding							X				X											
				Operators																						
			2.4.2.5	Application Qualification for Steel							X					X	RE									
				Studs																						
			2.4.2.4	Welding of Aluminum							X					X	RE									
			1.4	Certification							X					X	RE									
			1.4	Materials Disposition Records									X		X											

SUBMITTAL REGISTER
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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
05120

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Structural Steel System		X										X	RE									
			3.2.1	Structural Connections		X										X	RE									
			3.2	Erection					X							X	RE									
			1.3	Mill Test Reports							X					X	RE									
			1.3	Welder Qualifications							X					X	RE									
			3.1	Fabrication							X					X	RE									
			2.4	High Strength Bolts and Nuts								X				X	RE									
			2.5	Carbon Steel Bolts and Nuts								X				X	RE									
			2.6	Nuts Dimensional Style								X				X	RE									
			2.7	Washers								X				X	RE									

SUBMITTAL REGISTER
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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **05900**

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Flapgate Design	X											X	RE									
			1.2	Lists of Materials	X											X	RE									
			1.2	Shop Drawings		X										X	RE									
			1.2	Certification of Material tests and							X					X	RE									
				Analyses																						
			1.3.2	Certification							X					X	RE									

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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **05901**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Trash Racks		X										X	RE									
			1.2	Miscellaneous Metal Items								X				X	RE									

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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **06710**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Plan of Operations					X							X	GL									
			1.3	Conformance With Specification					X							X	GL									
				Certification																						
			1.3	Vinyl Sheet Piling Sample								X				X	GL									

SUBMITTAL REGISTER
(ER 415 1-10)

CONTRACT NO. DACW41-00LG

TITLE AND LOCATION
MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
08310

ACTIVITY NO a.	TRANSMITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERNMENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Design Calculations	X											X	AE.									
			1.3	Steel Doors and Frames		X										X	AE.									

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TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **09965**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Accident Prevention Plan					X							X										
			1.4	Waste Classification, Handling, and					X							X										
				Disposal Plan																						
			1.4	Visible Emissions					X							X										
			1.4	Special Paint Formulas								X				X	RE									
			1.4	Specification and Proprietary Paints								X				X	RE									
			1.4	Thinners								X				X	RE									
			1.4	Inspections and Operations									X			X										

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TITLE AND LOCATION
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CONTRACTOR

SPECIFICATION SECTION
11289

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.6	Sequencing and Scheduling	X											X	RE									
			2.2	manufactured units	X											X	RE									
			2.4.7	Fabrications	X											X	RE									
			2.4.1	Detail Drawings		X										X	RE									
			2.1	Materials				X							X											
			2.4.3	Welding					X							X	RE									
			2.5	Tests, Inspections, and Verifications						X					X											
			1.3	Materials Disposition									X		X											

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TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **15161**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.4	Materials	X											X	RE									
			1.4	Equipment Supplies and	X											X	RE									
				Performance																						
			1.4	Spare Parts	X										X											
			1.4	Computations	X											X	RE									
			1.4	Submersible Pump		X										X	RE									
			1.4	Installation Instruction Manual			X									X	RE									
			1.4	Factory Test					X						X											
			1.4	Field Test					X							X	RE									
			1.4	Materials					X							X	RE									
			1.4	Pump Erection Engineer Resume					X							X	RE									
			1.4	Casting Acceptance Criteria					X							X	RE									
			1.4	Test Set-Up Plan					X							X	RE									
			1.4	Quality Assurance Field Test Plans					X							X	RE									
			1.4	Installation List					X							X	RE									
			1.4	Factory Test						X						X	RE									
			1.4	Field Test						X						X	RE									
			1.4	Motor Tests						X					X											
			1.4	Installation Report						X					X											
			1.4	Operating and Maintenance										X		X	RE									
				Instruction																						

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CONTRACTOR

SPECIFICATION SECTION
15200

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.5	Lists of Materials	X											X	RE									
			1.5	Design Requirements	X											X	RE									
			1.5	Shop Drawings		X										X	RE									
			1.5	Quality Control						X						X	RE									
			1.5	Materials, Procedures, and							X					X	RE.									
				Qualifications																						

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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **15301**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Lists of Materials	X											X	RE									
			1.2	Design Requirements	X											X	RE									
			3.4.2	Tests	X											X	RE									
			3.4	FIELD INSTALLATION AND TESTS	X											X	RE									
			1.2	Shop Drawings		X										X	RE									
			1.2	Quality Control						X						X	RE									
			1.2	Materials, Procedures, and							X					X	RE.									
				Qualifications																						

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CONTRACT NO. DACW41-00LG

TITLE AND LOCATION: **MRLS L385 Riverside/Quindaro Bend, MO**

CONTRACTOR:

SPECIFICATION SECTION: **15302**

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.2	Lists of Materials	X											X	RE									
			1.2	Design Requirements	X											X	RE									
			1.2	Shop Drawings		X										X	RE									
			1.2	Quality Control						X						X	RE									
			1.2	Materials, Procedures, and							X					X	RE.									
				Qualifications																						

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CONTRACTOR

SPECIFICATION SECTION
16370

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL										CLASSI-FICATION		REVIEWER r.	CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVERNMENT ACTION		REMARKS aa.
					DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	INFORMATION ONLY p.	GOVERNMENT APPROVED q.		SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	CODE y.	DATE z.	
			1.3	Fault Current and Protective Device	X											X	RE									
				Coordination Study																						
			1.3	Manufacturer's Catalog	X											X	RE									
			1.3	Material, Equipment, and Fixture	X											X	RE									
				Lists																						
			1.3	Installation Procedures	X											X	RE									
			1.3	Electrical Distribution System		X										X	RE									
			1.3	As-Built Drawings		X										X	RE									
			1.3	Factory Test						X						X	RE									
			3.11	Field Testing						X						X	RE									
			2.20	FACTORY TESTS						X						X	RE									
			1.3	Test Reports						X						X										
			1.3	Materials and Equipment							X					X	RE									
			1.3	Electrical Distribution System										X		X	RE									

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MRLS L385 Riverside/Quindaro Bend, MO

CONTRACTOR

SPECIFICATION SECTION
16375

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Fault Current and Protective Devices	X											X										
				Coordination Studies																						
			1.3	Manufacturer's Catalog Data	X											X	RE									
			1.3	Material, Equipment, and Fixture	X											X	RE									
				Lists																						
			1.3	Installation Procedures	X											X	RE									
			1.3	Electrical Distribution System		X										X	RE									
			1.3	As-Built Drawings		X										X	RE									
			1.3	Factory Test						X						X	RE									
			1.3	Field Testing						X						X	RE									
			1.3	Test Reports						X						X	RE									
			1.3	Cable Installation Reports						X						X	RE									
			1.3	Materials and Equipment							X					X	RE									
			1.3	Cable Installer Qualifications							X					X	RE									
			1.3	Electrical Distribution System										X		X	RE									

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CONTRACT NO.
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TITLE AND LOCATION
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CONTRACTOR

SPECIFICATION SECTION
16403

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Equipment	X											X	RE									
			1.3	Outline Drawings		X										X	RE									
			2.6	Motor Control Center		X										X	RE									
			2.7	Panelboards		X										X	RE									
			2.9	Factory Tests					X						X											
			2.9	Factory Tests						X					X											
			2.6	Motor Control Center							X				X											

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CONTRACT NO.
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CONTRACTOR

SPECIFICATION SECTION
16415

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	O&M MANUALS o.	CLASSIFICATION: INFORMATION ONLY p.	CLASSIFICATION: GOVERNMENT APPROVED q.	REVIEWER r.	CONTRACTOR SCHEDULE DATES: SUBMIT s.	APPROVAL NEEDED BY t.	MATERIAL NEEDED BY u.	CONTRACTOR ACTION: CODE v.	DATE w.	SUBMIT TO GOVERN-MENT x.	GOVERNMENT ACTION: CODE y.	DATE z.	REMARKS aa.
			1.3	Manufacturer's Catalog	X											X	RE									
			1.3	Material, Equipment, and Fixture	X											X	RE									
				Lists																						
			1.3	Installation Procedures	X											X	RE									
			1.3	Interior Electrical Equipment		X										X	RE									
			1.3	As-Built Drawings		X										X	RE									
			1.3	Onsite Test					X							X	RE									
			1.3	Materials and Equipment							X					X	RE									

SECTION 01355

ENVIRONMENTAL PROTECTION
10/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions
40 CFR 68	Chemical Accident Prevention Provisions
40 CFR 152 - 186	Pesticide Programs
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
49 CFR 171 - 178	Hazardous Materials Regulations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) U.S. Army Corps on Engineers Safety and Health Requirements Manual
WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.6 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.7 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.8 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.9 Wetlands

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

1.6 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only. When used, a designation following the "GA" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Environmental Protection Plan; GA-RE, PM-PR .

The Environmental Protection Plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer and PM-PR (Schuettpelz). The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail

commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer and PM-PR (Schuettpelz) for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan. The erosion and sediment control must satisfy all requirements of the Missouri Department of Natural Resources for and NPDES land disturbance permit.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer and the local Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons

along with the percent that was diverted.

l. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

m. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

n. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

o. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

p. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel, the Contracting Officer, and PM-PR (Ziegler).

q. A pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management

record keeping and reporting requirements as well as any additional specific requirements.

1.7.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached,as an appendix, to the Environmental Protection Plan.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.9 SPECIAL ENVIRONMENTAL REQUIREMENTS

The Contractor shall comply with the special environmental requirements included at the end of this section.

1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings,plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and PM-PR (Schuettpelz), and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer, after consultation with PM-PR, determines that the proposed alternate method will have an adverse environmental impact.

1.11 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations shall be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and

outfall protection, diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering, removal of cofferdams, tailrace excavation, and tunnel closure shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State of Missouri water quality standards and anti-degradation provisions.

3.3.2 Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments.

3.3.3 Wetlands

The Contractor shall not enter, disturb, destroy, or allow discharge of contaminants into any wetlands. The Contractor shall be responsible for the protection of wetlands shown on the drawings in accordance with paragraph ENVIRONMENTAL PERMITS, REVIEWS, AND APPROVALS. Authorization to enter specific wetlands identified shall not relieve the Contractor from any obligation to protect other wetlands within, adjacent to, or in the vicinity of the construction site and associated boundaries.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from

asphaltic batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of Missouri rules.

3.4.4 Burning

See SECTION: GENERAL for open burning requirements.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site shall be accordance with all Federal, State, and local laws and regulations.

3.5.5 Waste Water

Disposal of waste water shall be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water by collecting and placing it in a retention pond where suspended material can be settled out and/or the water can evaporate to separate pollutants from the water. The site for the retention pond shall be coordinated and approved with the Contracting Officer. The residue left in the pond prior to completion of the project shall be removed, tested, and disposed off-Government property in accordance with Federal, State, and local laws and regulations. The area shall be backfilled to the original grade, top-soiled and seeded/sodded.

b. For discharge of ground water, the Contractor shall surface discharge in accordance with all Federal, State, and local laws and regulations.

c. Water generated from the flushing of lines after hydrostatic

testing shall be land applied in accordance with all Federal, State, and local laws and regulations for land application.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.8 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.9 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.10 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.11 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct

environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.13 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION 01451A

CONTRACTOR QUALITY CONTROL
07/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable

to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than 20 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Contracting Officer.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization.The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, show drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 2 years construction experience on construction similar to this contract, or a construction person with a minimum of 5 years in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned as System Manager but may have duties as project superintendent in addition to quality control. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors". If the Contractor needs this training, it will be provided by the Government.

3.4.4 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the portion of the plan for the work to be

performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the

deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the

proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $3,500 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at the following address:

For delivery by mail:

USACE Research and Development Center
ATTN: Joe Tom, CEERD-SC-E
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

For other deliveries: Same as above.

Coordination for each specific test, exact delivery location, and dates will be made through the Area Office.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the Special Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that

the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and

references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

SECTION 01500A

TEMPORARY CONSTRUCTION FACILITIES
02/97

1.1 GENERAL REQUIREMENTS

1.1.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.1.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.1.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Payment for Utility Services

The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.

1.2.2 Meters and Temporary Connections

The Contractor, at its expense and in a manner satisfactory to the Contracting Officer, shall provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility used for the purpose

of determining charges. The Contractor shall notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor shall not make the final electrical connection.

1.2.3 Advance Deposit

An advance deposit for utilities consisting of an estimated month's usage or a minimum of $50.00 will be required. The last monthly bills for the fiscal year will normally be offset by the deposit and adjustments will be billed or returned as appropriate. Services to be rendered for the next fiscal year, beginning 1 October, will require a new deposit. Notification of the due date for this deposit will be mailed to the Contractor prior to the end of the current fiscal year.

1.2.4 Final Meter Reading

Before completion of the work and final acceptance of the work by the Government, the Contractor shall notify the Contracting Officer, in writing, 5 working days before termination is desired. The Government will take a final meter reading, disconnect service, and remove the meters. The Contractor shall then remove all the temporary distribution lines, meter bases, and associated paraphernalia. The Contractor shall pay all outstanding utility bills before final acceptance of the work by the Government.

1.2.5 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.6 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1 Bulletin Board

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

1.3.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be as shown on the drawings. The signs shall be erected within 15 days after

receipt of the notice to proceed. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from the site.

1.4 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.4.1 Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Contracting Officer shall be removed.

1.4.2 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.5.2 Storage Area

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the military boundaries. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

1.5.3 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but shall be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.5.4 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the military property.

1.5.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

1.5.6 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.6 GOVERNMENT FIELD OFFICE

The Contractor shall furnish a temporary office facility a minimum of 24 feet by 44 feet and 1056 square feet of floor space that will accommodate and support the equipment and requirements below. It shall be located where directed and shall be reserved for Government personnel only. The temporary government office facility, including the parking area shall have an 8-foot security fence with triple barbed wire and outdoor security lighting. Parking shall include ten (10) off-street parking spaces adjacent to the temporary office. Cooled bottled drinking water facilities, adequate diffused, fluorescent lighting, local commercial telephone service, air conditioning, heating equipment, and a toilet room with water closet and lavatory with sewage facilities shall be furnished and maintained by the Contractor. All windows shall have operable windows and blinds. The office facility shall be divided to include a minimum of two (2) private office areas, one (1) private conference room and a common area that will accommodate four (4) additional workstations. Private offices and conference room shall include entry doors. Conference room shall be sized and equipped to provide a conference table and chairs to accommodate ten (10) people. Each office, conference room and workstation shall have electrical outlets, a dedicated phone line and computer connection. Offices and workstations shall include a desk, chair, ten feet of shelving located where directed, and one legal size filing cabinet with four drawers. Four additional 4-drawer file cabinets shall also be included in the common area. A plan table will be provided behind each desk as a work surface for full size drawings. The common area will include a telephone connection and power to support the required fax and copy machine. Other equipment that shall be provided includes the following:

· Three (3), 3ft x 4ft white marker boards to be installed where directed;
· Eight (8) coat hooks to be installed where directed;
· Three plan racks;
· Four (4) separate telephone lines, three (3) for voice and one for fax;
· One (1) ISDN data circuit (128k).
· Seven telephone instruments each capable of using the three voice telephone lines;
· Five (5) Dell OptiPlex GX240, Pentium 4, 1.7 GHz, 256K Cache, with PCI riser personal computers or equal with the following minimum capabilities:
o 4-PCI slots;
o 512MB, Non ECC, PC133 SDRAM;
o Tower case;
o 3.5 inch, 1.44MG floppy drive;
o 40GB, EIDE, 7200 RPM, ATA/100 hard drive;
o 48X internal EIDE CD-ROM;
o DVD-CDRW combo drive with decoder for Windows 2000;
o On-board enhance IDE/IO adapter 2F/4H, 2-Hi Speed Serial/1 BI-dir EPP Par. Port;
o 32MB, ATI, Rage Ultra 128, Video Card;
o Integrated Sound Blaster Compatible AC97 Sound Card;
o Harman/Kardon 19.5 speakers or equal;
o 104 enhanced keyboard;
o MS Windows 2000 Professional on CD-ROM and installed on CPU's;
o MS Office Pro 2000 on CD-ROM and installed on CPU's;
o 3-button PS/2 mouse and mouse pad;
o 10/100, Network Interface Card (NIC)
o 19" .26mm 1289x1024 flat screen computer monitor;
o On-site warranty for the duration of the contract;
o FCC Certified, Novell certified, Windows NT certified, Year 2000 compliant;
· One Dell OptiPlex GX240, Pentium 4 personal computer for use as a 'server' with the following capability:
o 4-PCI slots;

- 512MB, Non ECC, PC133 SDRAM;
- Tower case;
- 3.5 inch, 1.44MG floppy drive;
- 40GB, EIDE, 7200 RPM, ATA/100 hard drive;
- 48X internal EIDE CD-ROM;
- On-board enhance IDE/IO adapter 2F/4H, 2-Hi Speed Serial/1 BI-dir EPP Par. Port;
- 32MB, ATI, Rage Ultra 128, Video Card;
- 104 enhanced keyboard;
- 3-button PS/2 mouse and mouse pad;
- 10/100, Network Interface Card (NIC)
- 17" .26mm 1289x1024 computer monitor;
- On-site warranty for the duration of the contract;
- FCC Certified, Novell certified, Windows NT certified, Year 2000 compliant;
- MS Windows 2000 Professional on CD-ROM and installed on CPU's;
- Internal tape drive with Windows 2000 Pro compatible backup software.

· APC Batter Backup device with PowerChute software for server that will provide 15 minutes of backup power in the event of a power failure;
· ISDN router;
· 16-port switch sufficient for print sharing and file sharing;
· An established LAN within the Government facility to have a minimum of ten drops at locations designated by the Government;
· One laser printer with NIC, HP laser jet 8000N or equivalent capable of making 11 inch x 17 inch documents;
· One HP 1220c with NIC color printer capable;
· One copy of the NAS scheduling software that the Contractor intends to use to manage the project;
· One plain paper FAX machine;
· One copier with the following capabilities: Document feeder, Collating, Magnification & reduction, Duplex copies, Sorting, Stapling, 11inch x 17inch copies;
· Monitored (reporting) security alarm system;
· Six handheld cellular telephones, Motorola Model I700+ or equal with service for the duration of the project. Service shall be digital cellular iDEN technology with integrated digital push to talk 2-way radio coverage within Missouri and Kansas.
· One (1) Digital camera, Sony model DSC-P5, 3.34 megapixel with 32Mb Memory Stick, Model MSA-32A and two (2) Sony Memory stick Floppy Disk Adapters, Model MSAC-FD2MA.

Maintenance service contract for the computers, printer, router, hub, fax machine and copier shall be provided for the duration of the contract. Toner for the printer and copier shall be provided for the duration of the project. Building entrance doors shall be equipped with a substantial lock with seven (7) keys. Janitorial service shall be provided that includes trash removal, sweeping twice weekly, mopping and dusting weekly, window washing monthly, toilet tissue, hand towels, liquid hand soap. The contractor will not be liable for Government long-distance telephone calls. The Contractor shall provide janitorial service, heating, air conditioning, local telephone service, electricity, water, sewerage, office equipment maintenance and monitored security system at no additional cost to the Government for the duration of the project. The facility will be set up and completely operational with all items listed above functional within thirty days after the Notice to Proceed. The entire facility including all furniture, office equipment, camera, computers, printers, copier and communications equipment will remain the property of the Contractor and shall be removed from the site after completion of the work.

1.7 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The devices shall be made available for use by Government personnel.

1.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site.

1.9 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

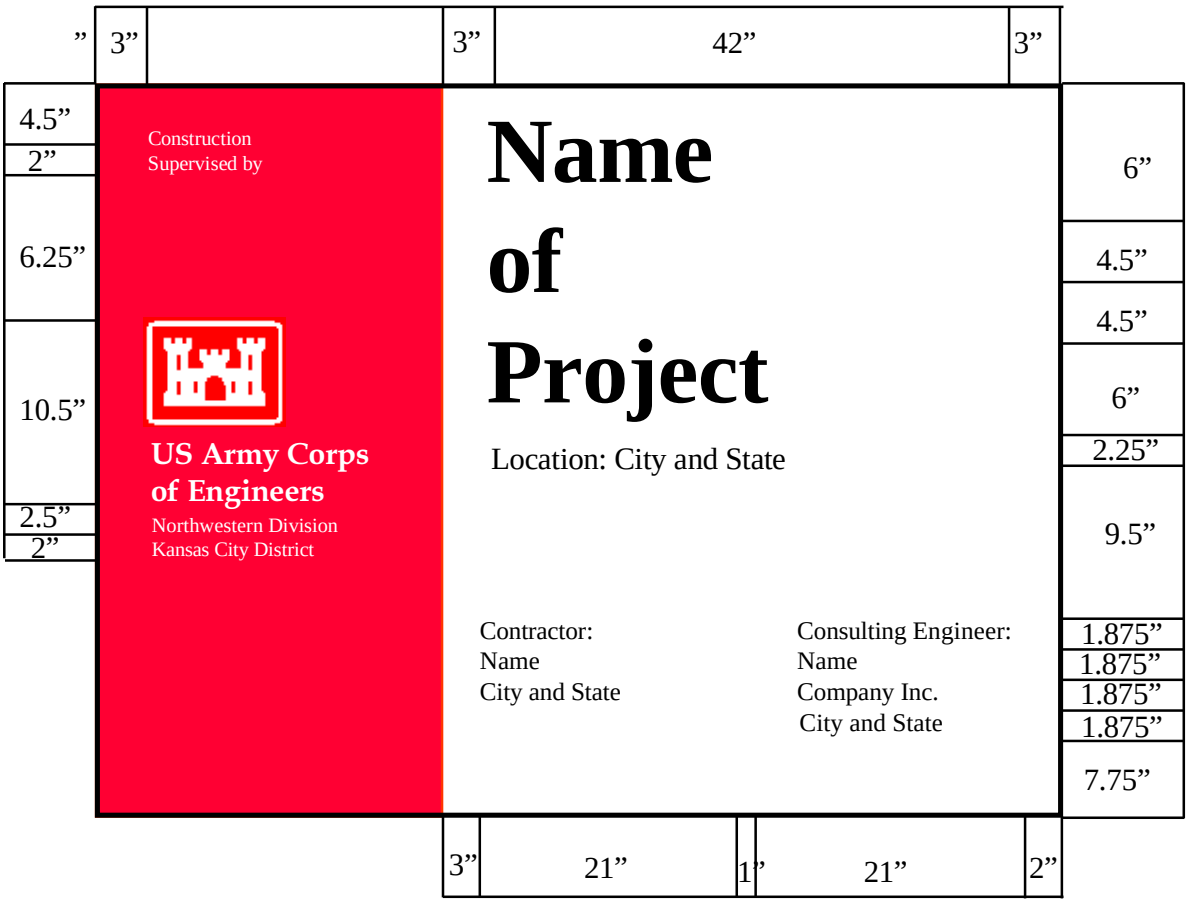
1.10 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

The graphic format for this 4'x 6' sign panel follows the legend guidelines and layout as specified below. The large 4'x 4' section of panel on the right is to be white with black legend. The 2'x 4' section of the sign on the left with with the full Corps signature (reverse version) is to be screen printed Communications Red on the White background.

This sign is to be placed with the Safety Performance Sign (See Fig. 2).



Legend Group 1: One to two-line description of Corps relationship to project
Color White
Typeface 1.25" Helvehca Regular
Maximum line lenth: 19"

Legend Group 2: Division\ District Name Placed below 10.5" Reverse Signature (6" Castle).
Color: White
Typeface: 1.25" Helvetica Regular

Legend Group 3: One- to three-line project title legend describes the work beging done under this contract.
Color: Black
Typeface: 3" Helvetica Bold
Maximum line length: 42"

Legend Group 4: One- to two-line identification of project or facility (civil works) or name of sponsoring department (military).
Color: Black
Typeface: 1.5" Helveticia Regular
Maximum line length: 42"

Cross-align the first line of Legend Group 4 with the first line of the Corps Signature (US Army Corps) as shown.

Legend Groups 5a-b: One- to five-line identification of prime contractors including: type (arcthitect, general contractor, etc.), corporate or firm name, city, state. Use of Legend Group 5 is optional.
Color: Black
Typeface: 1.25" Helvetica Regular
Maximum line length: 21"

All typography is flush left and rag right, upper and lower case with initial capitals only as shown.
Letter- and word-spacing to follow Corps standards

Sign Type	Legend Size	Panel Size	Post Size	Specification Code	Mounting Height	Color Bkg/Lgd
CID-01	Various	4' x 6'	4" x 4"	HDO-3	48"	WH-RD/BK

CONSTRUCTION SIGN (CORPS OF ENGINEERS DESIGN)
(Use with Fig 2)

Fig. 1

SAFETY PERFORMANCE SIGN

Each contractor's safety record is to be posted on Corps managed or supervised construction projects and mounted with the construction project identification sign.

The graphic format, color, size and typefaces used on the sign are to be reproduced exactly as specified below. The title with First Aid logo in the top section of the sign and the performance record captions are standard for all signs of the type. Legend Groups 2 and 3 below identify the project and the contractor and are to be placed on the sign as shown.

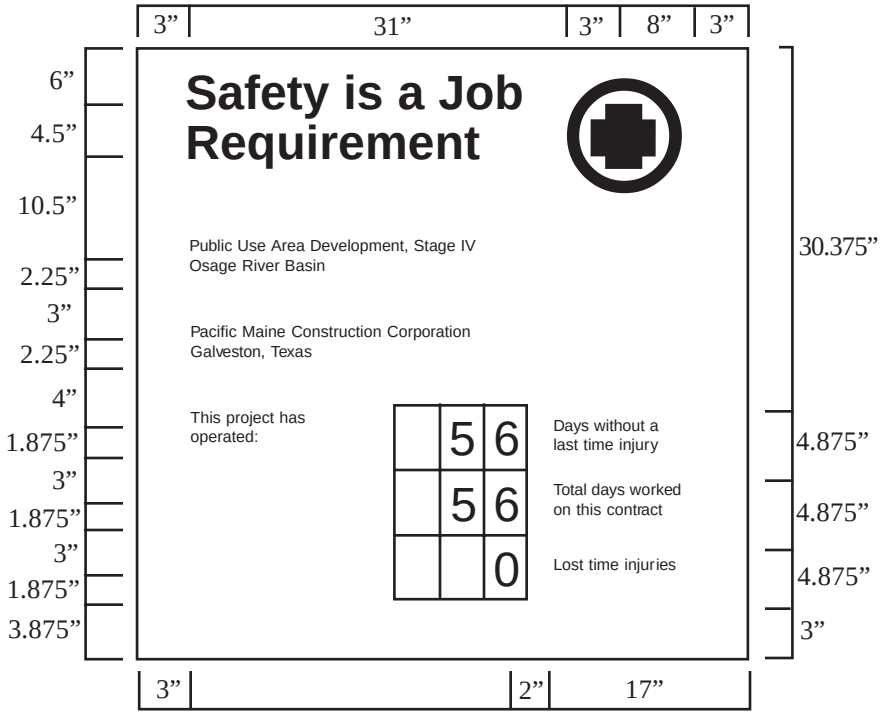
Safety record numbers are mounted on individual metal plates and are screw mounted to the background to allow for daily revisions to posted safety performance record.

Legend Group 1: Standard two-line title "Safety is a Job requirement" with (8 od.) Safety Green First Aid logo.
Color: to match PMS 347
Typeface: 3" Helvetica Bold
Color: Black

Legend Group 2: One to two-line project title legend describes the work being done under this contract and name of host project.
Color: Black
Typeface: 1.5" Helvetica Regular
Maximum line length: 42"

Legend Group 3: One to two-line identification; name of prime contractor and city, state address.
Color: Black
Typeface: 1.5" Helvetica Regular
Maximum line length: 42"

Legend Group 4: Standard safety record captions as shown.
Color: Black
Typeface: 12.5" Helvetica Regular



Sign Type	Legend Size	Panel Size	Post Size	Specification Code	Mounting Height	Color Bkg/Lgd
CID-02	Various	4' X 4'	4" X 4"	HDO-3	48"	WH/BK - GR

Replaceable numbers are to be mounted on white .060 aluminum plates and screw-mounted to background.
Color: Black
Typeface: 3" Helvetica Regular
Plate size: 2.5" X 5"

All typography is flush left and rag right. Upper and lower case with initial capitals only as shown. Letter - and word - spacing to follow Corps standards.

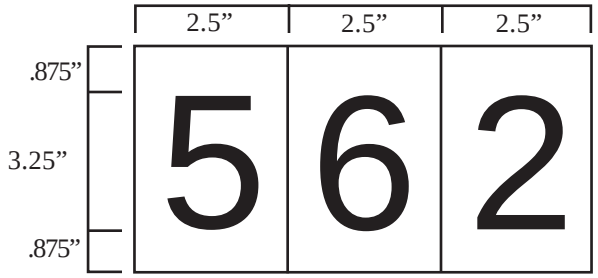


Fig. 2

SECTION 01780A

CLOSEOUT SUBMITTALS
11/99

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings; GA-RE.

Drawings showing final as-built conditions of the project. The final CADD as-built drawings shall consist of one set of electronic CADD drawing files in the specified format, one set of mylar drawings, 2 sets of blue-line prints of the mylars, and one set of the approved working as-built drawings.

SD-03 Product Data

As-Built Record of Equipment and Materials; GA-RE.

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan; GA-RE.

Two sets of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags; GA-RE.

Two record copies of the warranty tags showing the layout and design.

Final Cleaning; GA-RE.

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 As-Built Drawings

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file as-built drawings.

1.2.1.2 Working As-Built and Final As-Built Drawings

The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan. The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

(1) Directions in the modification for posting descriptive changes shall be followed.

(2) A Modification Circle shall be placed at the location of each deletion.

(3) For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.

(4) For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).

(5) For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the

contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only personnel proficient in the preparation of CADD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CADD files. The Contractor will be furnished Microstation 98 7.01 software and a Windows 2000 operating system. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make required corrections, changes, additions, and deletions.

a. CADD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

(1) Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.

(2) Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

b. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer #63.

c. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of

the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "AS-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

d. Within 20 days for contracts $5 million and above, after Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CADD as-built drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 10 days for contracts $5 million and above, the Contractor shall revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 20 days for contracts $5 million and above of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM) and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 Payment

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

1.2.2 As-Built Record of Equipment and Materials

The Contractor shall furnish one copy of the preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.2.3 Final Approved Shop Drawings

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 Construction Contract Specifications

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01800

HTRW CONTINGENCY PLAN
09/2000

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-02	(1995) 1995-1996 Threshold Limit Values or Chemical Substances and Physical Agents and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI

ANSI Z358.1	(1990) Emergency Eyewash and Shower Equipment

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 261	Identification and Listing of Hazardous Wastes
40 CFR 262	Standards Applicable to Generators of Hazardous Wastes
40 CFR 268	Land Disposal Restrictions
49 CFR 172-178	Transportation of Hazardous Materials
49 CFR 171	General Information, Regulations, and Definitions 49 CFR 172Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

ENGINEERING MANUALS

EM 385-1-1	1992) US Army Corps of Engineers Safety and Health Requirements Manual

ER 1110-1-263	(1990) Chemical Data Quality Management for Hazardous Waste Remedial Activities

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub No. 85-115	NIOSH Pub No. 85-115

ENVIRONMENTAL PROTECTION AGENCY

EPA-540/R-93-071	(1993) Data Quality Objectives Process for Superfund
EPA-450/4-89-015	(1989) Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites (Stages I & II)
EPA-450/4-90-005	(1991) Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites, (Stage III)
EPA SW-846	Test Methods for Evaluating Solid Waste

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Contingency Plan;GA-RE.

The Contingency Plan shall be submitted within twenty calendardays after Notice to Proceed. The Plan shall consist of a Site History Section, a Sampling and Analysis Plan Section, and a Site Safety and Health Plan Section. The Site Safety and Health Plan section of the Contingency Plan shall be signed and dated by the Contractor's Safety and Health Manager and the Site Superintendent.

1.3 SCOPE

This section details the required content, and implementation of a Contingency Plan (CP). The purpose of the CP is to establish, before work begins, field and laboratory procedures that shall be used to investigate potentially contaminated or hazardous material discovered during construction.

1.3.1 Content

The CP, as detailed in this section, describes Contractor capabilities and responsibilities that are necessary in order to accomplish site investigations in excess of those required in other sections of these specifications.

1.3.2 Implementation

The Contracting Officer in conjunction with the Contractor's Health and Safety Officer shall determine, upon discovery of site conditions warranting special consideration, if provisions of the CP will be implemented. The CP provisions shall only be executed at the direction of the Contracting Officer. If the CP is implemented, the Contractor shall perform additional work directed in conformance with this section. The additional work shall include disposal procedures. The local sponsor will provide the Hazardous Waste Disposal Number. Payment for any additional work will be according to paragraph "Payment for Contingency Plan Implementation" of this specification section.

1.4 GENERAL REQUIREMENTS

1.4.1 Contingency Plan Approval

Mobilization and other preliminary work approved by the COR may be performed before approval of the CP. Excavation, construction, and other field activities may not proceed until the CP has been approved by the COR. A copy of the approved CP shall be maintained on site if the CP is implemented.

1.4.2 Potentially Contaminated Material

If potentially contaminated material is encountered during any phase of construction, all work in the immediate area shall stop and the Contractor's Health and Safety Officer and the Contracting Officer shall be notified. Based on the initial inspection by the COR and SSHO, determination to implement the Contengency Plan shall be made according to paragraph IMPLEMENTATION. Payment for extra work required by implementing the CP is addressed in paragraph, PAYMENT FOR THE HTRW CONTINGENCY PLAN. Potentially contaminated material shall be identified by, but is not limited to, the following items:

a. Drums, tanks, or containers that contain unidentifiable substances encountered during excavation.

b. Stained soil.

1.5 REGULATORY REQUIREMENTS

Development of the CP, and subsequent work that may be done if the CP is implemented shall comply with EM 385-1-1, applicable Federal, state, and local safety and occupational health laws and regulations. This includes, but is not limited to, Occupational Safety and Health Administration (OSHA) standards, CFR 29 Part 1910, especially Section .120, "Hazardous Waste Site Operations and Emergency Response" and CFR 29 Part 1926, especially Section .65, "Hazardous Waste Site Operations and Emergency Response." Matters of interpretation of standards shall be submitted to the appropriate administrative agency or resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements

shall apply.

1.6 CHEMICAL QUALITY MANAGEMENT

A chemical data quality control system shall be established that meets the requirements for the chemical measurement data quality objectives applicable to the project. The system shall include chemical measurement requirements for both contractor and subcontractor produced chemical data. The system shall have a Chemical Quality Management staff that is responsible for the sampling and measurement plans, analytical procedures, minimum data reporting requirements, and the organization necessary to produce the required chemical data. If the Contingency Plan is implemented, the Contractor shall be responsible for chemical sample acquisition, sample analysis, instrumental measurements of chemical parameters, and for chemical data quality control.

1.7 DEFINITIONS

The definition of acronyms used by the Contractor that pertains to the Contingency Plan shall be clearly defined for all contract related products and communications.

1.8 MEASUREMENT AND PAYMENT

1.8.1 HTRW Contingency Plan

Separate measurement or payment will be made for for the HTRW Contingency Plan LS under HTRW Contingency Plan

1.8.2 HTRW Contingency Plan Implementation

If the Contingency Plan is implemented, payment for additional work, as required in this section or directed by the Contracting Officer, will be made under the paragraph "Changes" of the CONTRACT CLAUSES.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall develop and submit for approval a Contingency Plan that consists of a Sampling and Analysis Plan and a Site Safety and Health Plan.

3.2 SAMPLING AND ANALYSIS PLAN

The Sampling and Analysis Plan (SAP) shall be a two part document that contains two distinct elements: A Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). Sections of the FSP and QAPP may be cross referenced. The SAP shall confirm the Contractor's understanding of the government's requirements for chemical data quality control for the contract and provides direction to personnel responsible for field sampling and sample submittal for analysis, field chemical parameter measurement, data documentation, data validation and data reporting requirements. As a single interrelated document, the SAP shall be provided to both field and laboratory personnel. The SAP shall describe chemical parameter measurements for all matrices in the contract. In preparing the SAP, the Contractor may propose original/innovative approaches to chemical parameter

measurements for cost reduction and efficiency by abbreviated sampling, indicator or tracer analysis, on-site analytical services, equivalency or screening methods, etc., while complying with the chemical data quality requirements.

3.2.1 SAP Objective

The objective of the Sampling and Analysis Plan is to obtain usable chemical data. This shall be accomplished by following the protocols outlined in the United States Environmental Protection Agency's (USEPA's) Test Methods for Evaluating Solid Waste (SW-846). Chemical data obtained from a contingency action will be used to:

a. Identify chemical constituents of suspect material.

b. Ascertain if suspect material is a threat to human health and the environment.

c. Determine if further delineation of contamination is required.

d. Decide material characterization for proper handling and disposal.

3.2.2 Personnel Requirements and Qualifications

In the Sampling and Analysis Plan, the Contractor shall designate a Project Chemist. The Project Chemist shall have the overall responsibility of implementing the SAP and compliance of actual practices to the SAP if the Contingency Plan is implemented. The minimum educational requirements for the Project Chemist and Bench Chemists shall be a Bachelor of Science Degree in Chemistry. The Project Chemist shall have a minimum equivalent to 4 years full time hands on experience in organic analytical chemistry and a minimum equivalent of 2 years full time experience in inorganic analytical chemistry. Bench Chemists shall have a least 2 years experience in their assigned tasks. Technicians shall have a minimum of an associate of science degree plus six months of directly relatable experience and shall be used only for support functions and under the continuous supervision of Bench Chemist.

3.2.3 Data Evaluation Requirements

If the Contingency Plan is implemented, data collected shall be evaluated using SW-846 criteria. Data shall be rejected if any part of this criteria has not been met and no documented corrective actions have been taken. Rejected data is not usable. If corrective actions have been taken but QC criteria still could not be met, data shall be flagged providing the corrective action taken was the best possible corrective action as judged by the Contracting Officer. Such data shall be defined as usable. Quality data is data obtained in a sample batch for which all quality control criteria were met. The Contracting Officer will further evaluate the data by comparison with data from the USACE MRD QA laboratory. The Contracting Officer shall have the final decision as to the acceptability and quality of the data; however, the Contractor shall independently assess the data and arrive their own conclusions. The Contractor assessment shall be presented in the Chemical Quality Control Summary Report (CQCSR).

3.2.4 Data Completeness Requirements

Completeness for sample collection is defined as the percentage of samples directed to be collected for a contingency action that were actually

collected. This completeness shall be 95%. Completeness for usable data (as usable data is defined in paragraph "Site Safety and Health Plan Requirements") is defined as the percentage of usable data out of the total amount of data generated. This completeness shall be 98% for each of the individual analytical methods listed in the SAP. Completeness for quality data shall be 80% and is defined as the percentage of quality data out of the total amount of data generated.

3.2.5 Content of Field Sampling Plan

The FSP shall contain necessary technical detail and direction such that field personnel understand all sampling and field measurement requirements. It shall contain sufficient direction and detail that on-site personnel can perform all contingency action activities required to attain project data quality objectives (DQO), including; collection of samples for on-site and off-site chemical analysis, shipment of samples for off-site analyses, performance of on-site and off-site instrumental parameter measurements, and data documentation and reporting requirements. The FSP shall have a Title Page that includes project name and location followed by a Table of Contents and the following elements:

a. Project Organization and Responsibilities. The Project Organization and Responsibility Section of the FSP shall present relevant information on all Contractor/subcontractor positions that have responsibility for obtaining analytical data during a contingency action. Information in the section shall include the names of all personnel planned to participate in generation of analytical data from the collection and analysis of samples through final data report to include QA functions. At a minimum the following information shall be included:

1. Summary of Key Personnel. A brief summary of contractor management personnel and all key project personnel involved with on-site sample acquisition and delivery, on-site chemical parameter measurements, on-site data documentation and reporting, and corrective actions.

2. Points of Contact. Include to the extent possible, all key government, regulatory, contractor and any subcontractor personnel along with their location, address, phone numbers and organization affiliation. This section shall clearly identify to on-site personnel performing chemical measurements and acquiring chemical samples whom to contact for guidance and decision authority.

b. Scope and Objectives. The Scope and Objectives Section of the FSP shall contain, as a minimum, a summary of the types of contaminated material that may be encountered, the chemical parameters of concern, and the DQOs required to support the intended use of the chemical data for soil/sediments and water.

c. Sampling Requirements. The Sampling requirements Section of the FSP shall indicate that sample locations, sampling methods, and analysis to be conducted will be directed by the Contracting Officer.

d. Analytical Methods. The FSP shall indicate that analytical methods will be used in accordance with SW-846 methodologies. Analytical parameters that could be used for this project are shown in Table 1. The parameters that a sample will be analyzed for will be directed by the Contracting Officer. Method detection limits, quality control, and quality assurance requirements shall be those specified in the methods.

TABLE 1: ANALYTICAL PARAMETERS

Analyte	Technique	Extraction/Method	
		Soil	
		Sediment	Aqueous
Volatiles	GC/MS	5035/8260B	included/8260B
Semivolatiles	GC/MS	3540C,3510C,3550B/8270C	3520C/8270C
Pesticides	GC	3550B/8081A	3520C/8081A
PCB	GC	3550B/8082	3520B/8082
Se	GF	3050B/7740	included/7740
Hg	CV	included/7471A	included/7470A
As	GF	3050B/7060A	included/7060A
BTEX	GC	5030B/8020A	5030B/8020A
TPH	GC	8015B	
TCLP	extraction	1311	1311
Flash Point		1010	1010
Paint Filter		9095A	

e. Field Activities. The Field Activities Section of the FSP shall contain a description of the types of field activities that may be required during a contingency action and shall include, but not limited, to the following:

1. Sampling procedures and techniques to be followed during the collection of samples for chemical analysis.

2. Sampling and preservation procedures for each type of sample as specified in Table 1.

3. Sample numbering procedures for assigning a unique identification number to each sample including quality control/quality assurance samples.

4. Quality assurance/quality control (QA/QC) sampling requirements to include duplicates (blind), splits, blanks, rinsates, trip blank, government QA samples, etc. QA/QC split samples shall be collected at a 10% frequency or as a minimum, one per contingency action.

5. Field measurements.

6. Decontamination procedures to be used to ensure all sampling equipment is clean or precleaned. At a minimum, all equipment shall be decontaminated before and after conducting sampling at each location. All sample containers shall be obtained from a source that certifies them to be clean and that performs appropriate QC analysis to ensure cleanliness. The Contractor shall be responsible for the collection and disposal of all investigation derived wastes according to Local, State, and Federal

regulations.

f. Sample Chain-of-Custody/Documentation. The Sample Chain of Custody/Documentation (COC) Section of the FSP shall contain examples of the COC forms to be used on the project. All COC forms shall include, as a minimum, the following items:

1. A unique sample number.

2. Time and date acquired.

3. Sampler's name or initials.

4. Analysis to be performed.

5. Matrix type.

6. Preservation used.

7. Any special instructions.

The COC shall be signed by the person designated in the Project Organization and Responsibilities section. In addition, the COC must be signed by an authorized representative of the local sponsor.

g. Sample Packaging and Shipping. The Sampling Packaging and Shipping Section of the FSP shall contain, as a minimum, the following elements:

1. SOPs for sample labeling (including an example label), sample packaging, sample cooling, shipping procedures and procedures for corrective actions such that the sample integrity is established and maintained throughout custody process. Sample handling, packaging and shipping shall be in accordance with ER 110-1-263.

2. Shipping Companies that will be used to ship the project and government QA samples. Include address, phone numbers, and hours available for sample pickup or delivery.

3. Shipping Destinations, including the shipping addresses for all project chemistry labs, the government QA Lab and other regulatory labs. This section shall specify points-of-contact for all chemistry labs required for the project and include both phone numbers and addresses. This section shall include any prenotification time requirements for sample shipment and the receiving hours of the Labs.

h. Sampling Apparatus and Field Instrumentation. The Sample Apparatus and Field Instrumentation Section of the FSP shall contain, as a minimum, a general list of sampling equipment, apparatus, instruments, containers, supplies, standard forms and labels, and chemical reagents to be taken to the site. When applicable, equipment name, model, serial number, calibration equipment requirements, audit material requirements, and total number of each piece of equipment shall be provided.

i. Contractor Chemical Quality Control. The Contractor Chemical Quality Control Section of the FSP shall contain information that details implementation of a three phase quality control procedure required for chemical parameter measurement and sample acquisition and shipment. The procedure shall include a preparatory, initial and follow-up phase for each

definable feature of work. The contractor's three phase chemical data control procedure shall assure that minimum data reporting requirements are achieved and shall be implemented, if the Contingency Plan is implemented, according to ER 1180-1-6, EP 715-1-2 and CEGS 01440. The three phase process shall consist of the following:

1. The preparatory phase shall include a review of the specification, SAP, and all relevant SOPs for the chemical parameter measurement and/or chemical sample acquisition and shipment. It shall include a physical examination of all required forms, materials, and equipment to ensure conformance with the SAP and that all materials are on-site. It shall include a demonstration of sampling procedures by the contractor's field sampling personnel.

2. The initial phase shall be performed at the initiation of each definable work feature by the CQC Representative to confirm compliance with the SAP, including: instrument calibration, operation and performance checks, sample acquisition, labelling, and shipment in accordance with required SOPs, sampling equipment decontamination and required documentation.

3. The follow-up phase shall require daily inspections to ensure compliance with the SAP and shall not be complete without the daily chemical quality control reports.

j. Daily Chemical Quality Control Report (DCQCR). If the Contingency Plan is implemented, a DCQCR shall be generated by on-site personnel responsible for chemical parameter measurement and chemical sample acquisition. The report shall be signed by the person designated in the Project Organization and Responsibilities section to assure that chemical data resulting from these activities meets the contract documentation requirements. Format of the DCQCR shall be presented in the FSP. The DCQCR shall contain, as a minimum, the following:

1. Job identification and location descriptions.

2. Weather, including temperature, approximate wind speed and direction, significant wind changes, etc.

3. Chemical Data acquisition work performed, including who performed the sampling, specific information identifying project and QA samples collected, and calibrations.

4. Sampling and sample shipments including shipment and delivery problems that may affect project DQO requirements.

5. Chemical parameter measurement problems that may affect project DQO requirements, including instrument malfunction, performance requirement failure, etc.

6. Corrective Actions and/or deviations from the approved SAP including approvals.

7. Chemical quality control activities, as part of the three phase control procedures, that were implemented and confirmation that all deviations or actions jeopardizing project DQOs have been forwarded to project management. A summary of the feedback procedure for any corrective actions taken.

8. Signatures of responsible authority and initials of all persons conducting changes/corrective actions.

k. Corrective Actions. The Corrective Actions Section of the FSP shall contain, as a minimum, personnel responsible for project data quality objective monitoring, points-of-contact for discrepancies in sampling procedures, instrument calibration procedures, performance specification requirements, sample shipping and receiving, data check failures, data reporting, evaluation failures, and verification of corrective action implementation.

l. Appendices. The Appendices Section of the FSP shall contain, as a minimum, all Contractor standard forms and standard operating procedures that are referenced but not included previously. References, including project and Contractor specific, standard measurement methods, guidance documents, etc. shall also be included.

3.2.6 Contents of Quality Assurance Project Plan

The QAPP shall contain necessary technical detail and direction such that laboratory personnel understand all project sample analysis, quality control and data reporting requirements. It shall contain sufficient direction and detail that analytical laboratory personnel understand analytical methods, method required detection limits, method QC requirements, and data validation/reporting requirements. The QAPP shall have a Title Page, including the site specific project name and location followed by a Table of Contents and each of the following elements:

a. Project Organization and Responsibilities. The Project Organization and Responsibilities Section of the QAPP shall contain, as a minimum, an organizational chart depicting the following elements:

1. Summary of personnel, including a brief summary of key management personnel and all key laboratory personnel involved with sample analysis, project DQOs, documentation, corrective action procedures, data validation and reporting requirements. To the extent possible, all key personnel of all subcontractor organizations are required.

2. The locations, addresses, phone numbers and organizations of key government project management, regulatory personnel, and laboratories. This section shall clearly identify to laboratories performing project sample analysis whom to contact for sample receipt problems, data reporting problems, guidance, and decision authority, etc.

3. Personnel qualification requirements that specify project specific requirements for analytical laboratory personnel, such as organic and inorganic supervisors, laboratory Quality Assurance (QA) officers, etc. Analytical personnel requirements must be according to ER 1110-1-263.

b. Data Quality Objectives (DQO). The DQO Section of the QAPP shall contain, as a minimum, a definition of each sample analysis as required in the Paragraph 2.3.5.d. The DQOs shall clearly define to the analytical laboratories, for all samples submitted, the final uses of the analytical data. Contractor developed DQOs shall be in accordance with EPA-540/G-87/003 and shall address the following required key elements:

1. Precision

2. Accuracy

3. Representativeness

4. Comparability

5. Completeness

6. Method Sensitivity

7. Documentation

8. Data Validation

9. Data Reporting.

c. Sample Custody and Holding Times. The Sample Custody and Holding Times Section of the QAPP shall contain, as a minimum, the following laboratory requirements:

1. A copy of a generic sample receipt form that must be completed for each shipping container received and must include, as a minimum, the unique sample number, time and date acquired, sampler's name, preservative check, cooler temperature, analysis to be performed, matrix type, method holding time, and any special instructions.

2. The standard operating procedures for Intra-laboratory chain-of-custody requirements for all samples received and subsequently forwarded to another lab.

3. Project specific requirements for inter-laboratory sample custody, traceability including standards, spiking, witness and analyst initialling, etc.

d. Analytical Procedures. The Analytical Procedures Section of the QAPP shall contain, as a minimum, the following elements:

1. A table depicting the QC samples, analytical methods, and required method detection limits for each analysis of solid materials such as; soils, sludges, borrow materials, material for off-site transportation and disposal, etc.

2. A table depicting the QC samples, analytical methods and required method detection limits for each analysis of liquid media such as groundwater, surface water, etc.

e. Calibration Procedures and Frequency. The Calibration Procedures and Frequency Section of the QAPP shall contain, as a minimum, the following:

1. Calibration procedures.

2. Calibration schedules.

3. Detection limit and retention time window files.

4. Performance acceptance criteria and calibration verifications for each analytical procedure required.

The selected laboratory's Laboratory Quality Management Manual (LQMM) may be submitted as an appendix to partially fulfill this requirement.

f. Internal QC Checks. The Internal QC Checks Section of the QAPP shall contain, as a minimum, the following:

1. Batch definition.

2. Continuing calibration verifications.
3. Blanks.
4. Audits Surrogate and spike recovery criteria.
5. Internal standards.
6. Government and intralaboratory studies.
7. Matrix and duplicate matrix spike results.
8. Standard reference material and traceability.
9. Monitor or instrument audits and performance audit sample results.

The selected laboratory's LQMM may be submitted as an appendix to partially fulfill this requirement.

g. Calculation of Data Quality Indicators. The Calculation of Data Quality Indicators Section of the QAPP shall contain, as a minimum, the following:

1. Calculations used to determine method detection limits and standard deviation of replicate analysis.

2. Accuracy from matrix spikes or standard reference materials.

3. Precision from duplicate analysis and includes standard deviation from triplicate analysis and completeness based on the number of measurements judged valid.

4. The total number of measurements required.

The selected laboratory's LQMM may be submitted as an appendix to partially fulfill this requirement.

h. Corrective Actions. The Corrective Actions section of the QAPP shall contain, as a minimum, the following:

1. The corrective action criteria for sample receipt problems, sample holding times, analytical QC problems, etc., and the CPs for each implemented corrective action.

2. Personnel points of contacts for persons responsible for corrective action reporting, implementation, and documentation consistent with the organizational chart responsibilities.

i. Data Reduction, Validation and Reporting. The Data Reduction, Validation and Reporting section of the QAPP shall contain, as a minimum, the following:

1. Data reduction procedures. The methods or equations of concentration calculations, reporting units of concentrations, treatment of blank data, significant figures, moisture related data and the procedure for calculating precision and accuracy.

2. Data validation procedures used for all laboratory chemical data, flagging and data qualifying procedures, required levels of validation and

the responsible personnel for each analytical lab and data validation confirmation by successive lines of review as assigned in QAPP organization.

3. Data Reporting, including chemical data flow, analysis and reporting turnaround times, minimum data reporting requirements, destinations and delivery times for each report and data reporting formats such as SW-846, Contract Laboratory Plan (CLP), or other government agency specific formats.

4. Project specific reporting requirements, including Chemical Data Interim Report (CDIR) frequency and the minimum data reporting requirements to the Government QA Lab, specific data and time requirements for each lab and data report destination points.

j. Preventative Maintenance. The Preventative Maintenance section of the QAPP shall contain, as a minimum, the preventative maintenance plan/s to be implemented by each on-site and off-site laboratory to minimize downtime of laboratory instruments. The selected laboratory's LQMM may be submitted as an appendix to partially fulfill this requirement.

k. Performance and System Audits. The performance and system section of the QAPP shall contain, as a minimum, lab validation audits, method required audits, regulatory required audits, etc. for each on-site and off-site chemical analytical laboratories. The selected laboratory's LQMM may be submitted as an appendix to partially fulfill this requirement.

l. QC Reports to Management. The QC reports to management section of the QAPP shall contain as a minimum, the format for reporting an assessment of data accuracy, precision and completeness, personnel responsible for reporting, personnel receiving the reports and the frequency of the reports.

m. Appendices. The appendices section of the QAPP shall contain, as a minimum, the following:

1. Standard forms.

2. Definitions.

3. Acronyms.

4. References pertaining to the project requirements included in the QAPP relating to project DQOs.

5. Standard and nonstandard measurement methods.

6. Equivalency data.

7. US Government and regional agency guidance and regulatory documents.

8. Existing site related documents.

9. Other contract related chemical analysis documents, etc.

SOPs required in the above elements may be included in the Appendices and referenced in the applicable element.

3.2.7 Chemical Quality Control Summary Report (CQCSR)

If the Contingency Plan is implemented, the Contractor shall submit a CQCSR to the Contracting Officer within 15 days following completion of the contingency action. The CQCSR shall include a summary of all chemical parameter measurement activities. The summary shall include an evaluation of the achievement of the construction contract required chemical DQOs. The CQCSR shall contain, as a minimum, the following elements:

a. Sampling Procedures. Describe deviation from SAP and resultant effect on data.

b. Sample Handling and Sample Custody. Describe deviation from SAP in the sample handling, resultant effect on data collected, and rationale for deviation. Describe rationale for deviation in sample custody procedures.

c. Equipment Calibration and Maintenance. If any alterations to these procedures as described in the SAP were used, describe the procedure used in detail, and discuss the reasons for the alterations.

d. Analytical Procedures Used. If the standard methods (EPA, NIOSH, ASTM, etc.) were used, simply list the analytes and the number of the method used for each analyte. If any alterations to the standard methods were used, describe the alterations in detail and discuss why the methods were altered. Analytical procedures other than standard EPA methods (NIOSH for air monitoring) must have Corps of Engineers (CE) approval before being used. If non-standard methods were used, but not previously described in the SAP, describe the method in detail in the CQCSR. The detailed analytical procedure may be placed in the appendices and discussed in the body of the CQCSR. The following factors shall be addressed in this description:

1. Describe changes in instrumentation (make and model including detectors), operating parameters including chromatography columns, if applicable, and chemicals (state source and purity).

2. Standards. Describe changes from SAP. Include calibration standards.

3. Procedures. Describe changes in extraction of the sample (if applicable), for analyzing the sample or its extract, and for validating the method for the matrices in question (method blanks, calibration checks, recoveries, reference standards, replicate analyses, split samples, spiked samples, standard additions, etc.).

4. References. Cite sources for each method used.

e. Data Analysis and Validation. Description of the statistical procedures used in the assessment of data, including the use of control limits, if applicable. Discuss outliers and how they were treated. Discuss any results which seem to show bias or larger than expected standard deviations.

f. Data Summaries. The data summaries shall consist of the following:

1. A summary of analytical results listing which chemicals were found at what concentration levels at various locations of the site, and types of samples. To satisfy this requirement, a table of analytical results (positive hits only) by client sample number and laboratory sample number shall be presented along with a minimum of one map with client

sample numbers written next to their locations. Alternatively, map(s) only with sample numbers and analyte identity and concentrations located. Complete analytical results shall be included in the appendix (see paragraph g below).

2. A summary of the contract laboratory's QC analysis results. The summary shall consist of a table listing each QC result outside of established criteria. The established criteria shall be listed next to the result. QC results within criteria do not have to be listed separately, but summarized by number. Complete QC results shall be included in the appendix (see paragraph g below). Comments shall be included on how these data affect the validity of analytical results of the samples.

g. System Audits. Report on any inspections performed including when and by whom, any deficiencies encountered, and corrective actions taken.

h. Chemical, Analytical and QC/QA Problems Encountered. This section should include the degree to which each analytical system met or failed to meet the Data Quality Objectives (DQO) summarized in the SAP. Problems, especially those not anticipated in SAP and their respective resolutions should be noted. Examples might include but are not limited to:

1. Additional chemicals for which analyses should have been conducted.

2. Unexpected chemicals found which were due to secondary reactions or degradation processes.

3. Safety problems which might have been eliminated or reduced by better understanding of chemistry.

4. Analytical methods which did not work properly or which required modification for certain types of samples.

5. Analytical results which showed greater than expected variability, and the reasons for their variability calibration, instrumentation breakdown problems, and their resolution.

6. Specific QC/QA checks which should be increased or decreased, e.g., more field blanks, etc.

i. Appendices to the CQCSR. The appendices to the CQCSR report shall contain the following items:

1. The Daily Quality Control Reports.

2. All analytical data including the QC data required for the contract. The analytical data shall include the client ID number (sample number) with the corresponding laboratory ID number (if used).

3. Photocopies of an example of each of the types of documentation used to control data collection, labeling, analysis, and reporting. The appendix, however, shall include complete copies of the Chain-of-Custody forms, Cooler Receipt Forms, and Field Daily Quality Control Reports.

3.2.8 Chemical Data Interim Report (CDIR)

After completion of a contingency action, a CDIR shall be produced and provided through USACE management to the USACE Quality Assurance lab assigned to the project. It is equivalent to the Data Report to the QA Laboratory as specified on page D-11 of ER 1110-1-263 and meets the requirements stated in the Aug 16, 1989 memorandum from the Missouri River Division. The CDIR serves as part of the follow-up phase of the quality control system mechanism. The CDIR enables the government QA function to compare QA sample results to corresponding primary sample results to enable the government to assess the contractor's compliance with the SAP and initiates corrective actions. The CDIR shall contain, as a minimum, the following elements:

a. A summary of all chemical samples acquired during the specified interim period including sample number, collection date, analytical parameter, shipment date, COC forms, laboratory receipt date, sample receipt forms, sample prep date and sample analysis date.

b. A summary of all corresponding QA samples acquired and sent to the lab including the collection dates and sample identifications. The summary shall include a table which relates project and QA samples.

c. A summary of all chemical analysis for the samples including the following laboratory QC procedures and results: 1) accuracies from surrogate spike recoveries, matrix spikes and spike duplicates and laboratory control samples, 2) precisions from matrix spikes and spike duplicates, field duplicates and laboratory duplicates, 3) method blank results, 4) rinsate results and, 5) holding time discrepancies.

d. A summary of all analytical activities which result in deviations/effects the PARCC project goals.

e. Evidence that deviations were provided to management authority responsible for Chemical QC.

f. Summary of all corrective actions taken to correct deficiencies/deviations from contract requirements.

3.2.9 Analytical Testing Laboratories

The Contractor shall propose, when the Contingency Plan is submitted, the analytical laboratory or laboratories to be used for all sample analyses. All project laboratories performing process, non-process, air and off-site sample analysis must have attained a USACE validation. The Contractor has the option of performing chemical analyses either onsite or offsite by the contractor's or subcontractor's lab to achieve the primary required sample analyses. Before sample analysis, all analytical laboratories shall have attained USACE validation in accordance with EM 200-1-1. The Contractor is responsible for all chemical data and the project required chemical data quality and must not use laboratories until USACE validation is attained.

3.2.9.1 Laboratory Analytical Requirements

The Contractor shall provide chemical analysis directed by the Contracting Officer either by the contractor's and/or by subcontractor's laboratory. The Contractor shall provide chemical analysis for all parameters by methods specified in SAP or as directed by the Contracting Officer to achieve the project DQOs. Three days turn around shall be required on all analytical samples submitted for analysis unless otherwise directed by the

Contracting Officer.

3.2.9.2 Laboratory Performance

The Contractor shall provide and/or require continued acceptable analytical performance and shall establish a procedure to address data deficiencies noted by review and/or quality assurance sample results. The Contractor must provide and implement a mechanism for providing all analytical labs with the SAP or QAPP portion of the SAP, for monitoring all labs performance and for performing corrective action procedures. The Contractor is responsible for acquiring analytical services with additional USACE validated laboratories in the event a project lab loses its USACE validation status during the project.

3.2.10 Documentation

Documentation records are required to provide factual evidence that required chemical data has been produced and chemical data quality has been achieved. The documentation shall comply with the requirements specified in Paragraphs Sampling and Analysis Plan, Daily Chemical Quality Control Report, Chemical Data Interim Report and Chemical Quality Control Summary Report.

3.3 SITE SAFETY AND HEALTH PLAN

A Site Safety and Health Plan (SSHP) shall be prepared and submitted for approval covering work anticipated to be performed if the Contingency Plan is implemented. The Safety and Health Manager shall be responsible for the development, implementation and oversight of the SSHP. The SSHP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed during a contingency action. The SSHP shall address site-specific safety and health requirements and procedures based upon suspected site-specific conditions. The level of detail provided in the SSHP shall be general in nature and address the type of work it is anticipated will be performed. Details about some activities may not be available when the initial SSHP is prepared and submitted. Therefore, the SSHP shall address, as defined by this specification, anticipated tasks, their related hazards and anticipated control measures. Additional details shall be included in the activity hazard analyses as described in paragraph "Activity Hazard Analysis".

3.3.1 Field Changes

The SSHP shall be adapted to new situations and new conditions. Changes and modifications to the accepted SSHP shall be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Should any unforeseen hazard become evident while the CP is implemented, the Site Safety and Health Officer (SSHO) shall bring such hazard to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard on site personnel, visitors, the public, and the environment.

3.3.2 Availability

The SSHP shall be made available in accordance with CFR 29 Part 1910,

Section .120 (b)(1)(v) and CFR 29 Part 1926, Section .65 (b)(1)(v).

3.3.3 Site Safety and Health Plan Requirements

Topics required by CFR 29 Part 1910, Section .120 (b)(4) CFR 29 Part 1926, Section .65 (b)(4) and those described in this section shall be addressed in the SSHP. Where the use of a specific topic is not applicable to the project, the SSHP shall include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given the topic. Where adequate detail can not be given due to the unknown nature of the hazard, the SSHP shall give good general procedures with the knowledge the procedures will have to be adapted when contamination is encountered.

3.3.3.1 Staff Organization, Qualifications, and Responsibilities

An organizational structure shall be developed that sets forth lines of authority (chain of command), responsibilities, and communication procedures concerning site safety, health, and emergency response. This organizational structure shall cover management, supervisors and employees of the Contractor and subcontractors. The structure shall include the means for coordinating and controlling work activities of subcontractors and suppliers. The SSHP shall include a description of this organizational structure as well as qualifications and responsibilities of each of the following individuals. The Contractor shall obtain Contracting Officer's acceptance before replacing any member of the Safety and Health Staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement. At a minimum, the Safety and Health Staff shall contain the following persons:

a. The Contractor's Certified Industrial Hygienist identified in the ACCIDENT PREVENTION PLAN shall act as the Contractor's Safety and Health Manager as identified in this plan. The Safety and Health Manager shall:

1. Be responsible for the development, implementation, oversight, and enforcement of the SSHP.

2. Sign and date the SSHP prior to submittal.

3. Conduct initial site-specific training.

If the Contingency Plan is implemented, the CIH shall:

4. Be present on site during the first day of contingency activities and as necessary to ensure compliance with SSHP requirements.

5. Visit the site as needed to audit the effectiveness of the SSHP.

6. Be available for emergencies.

7. Provide on site consultation as needed to ensure the SSHP is fully implemented.

8. Coordinate any modifications to the SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.

9. Provide continued support for upgrading/downgrading of the level of personal protection.

10. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.

11. Review accident reports and results of daily inspections.

12. Serve as a member of the Contractor's quality control staff.

c. An individual shall be designated the Site Safety and Health Officer (SSHO). The person identified to be in charge of site safety and health in the Contractor's Accident Prevention Plan may be designated as the SSHO, if qualified. The name, qualifications, education, training summary, and work experience of the Site Safety and Health Officer shall be included in the SSHP. The SSHO shall have a minimum of 1 year experience in implementing safety and health programs at hazardous waste sites or in the hazardous waste disposal industry where Level C personal protective equipment was required. The SSHO shall have experience in construction techniques and construction safety procedures and have a working knowledge of Federal and state occupational safety and health regulations. The SSHO shall have training in personal and respiratory protective equipment program implementation, confined space program oversight, and in the proper use of air monitoring instruments, and air sampling methods. The Site Safety and Health Officer shall:

1. Assist and represent the Safety and Health Manager with site training and the implementation and enforcement of the accepted SSHP, if the Contingency Plan is implemented.

2. If the Contingency Plan is implemented, be assigned to the site of a contingency action on a full time basis for the duration of field activities. The SSHO shall have no duties other than Safety and Health related duties. If operations are performed during more than one work shift per day, a Site Safety and Health Officer shall be present for each shift.

3. Have authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the SSHP including, but not limited to, activity hazard analyses, air monitoring, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log.

4. Have responsibility and authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

5. Consult with and coordinate any modifications to the SSHP with the Safety and Health Manager, the Site Superintendent, and the Contracting Officer.

6. Review results of daily quality control inspections in the contaminated area and document safety and health findings into the Daily Safety Inspection Log.

7. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

3.3.3.2 Contamination Characterization

The SSHP shall include a list of contaminants that may present occupational health and safety hazards. This list shall be created by evaluating the site histories and analytical results provided in the Site Investigation Report. The contamination characterization shall be reviewed and revised if new chemicals are identified as work progresses.

3.3.3.3 Hazard/Risk Analysis

The SSHP shall include a safety and health hazard/risk analysis for each contingency action task and operation expected to be performed with potentially contaminated material. Available site information shall be reviewed when preparing the "Hazard/Risk Analysis" section of the SSHP. The Hazard/Risk Analysis section of the SSHP shall describe the chemical, physical, and toxicological properties of contaminants, sources and pathways of employee exposures, anticipated on site and offsite exposure level potentials, and regulatory (including Federal, state, and local) or recommended protective exposure standards. The SSHP shall also address employee exposure to hazardous substances brought on site, and shall comply with the requirements of CFR 29 Part 1910, Section .1200 and CFR 29 Part 1926, Section .59, Hazard Communication. The following elements, at a minimum, shall be addressed and may be presented in Table format:

a. Safety Hazards: Excavation, heavy equipment, and underground and overhead utilities.

b. Chemical Hazards: A record of potential site contaminants and a descriptions of the sites is provided is available to assist in preparing the SSHP. Construction will take place in areas that to be excavated has elevated levels of petroleum hydrocarbons, and lead.

c. Physical Agents: Noise, and confined space, heat and cold stress.

d. Biological Hazards: Poisonous plants, snakes, and tics.

e. Action Levels: Action levels shall be established for the situations listed below, at a minimum. The action levels and required actions (engineering controls, changes in PPE, etc.) shall be presented in the SSHP in both text and tabular form.

1. Implementation of engineering controls and work practices.

2. Upgrade or downgrade in level of personal protective equipment.

3. Work stoppage and/or emergency evacuation of on site personnel.

4. Prevention and/or minimization of public exposures to hazards created by site activities.

f. Site Tasks and Operations: Address the logistics and resources required to complete the projected tasks and objectives of the Contingency Plan. Based on the type of work anticipated, the following is a list of site tasks and operations that may be required:

1. Surface and subsurface sample collection.

2. Decontamination of personnel and sampling equipment.

3. Excavation of contaminated material.

A complete list of site tasks and operations, can not be developed at this time. If the Contingency Plan is implemented, the list may have to be expanded and/or revised.

3.3.3.4 Exposure Monitoring/Air Sampling Program

An exposure monitoring/air sampling program shall be presented in the SSHP to identify and quantify safety and health hazards and airborne levels of hazardous substances. The program shall be implemented if the Contingency Plan in implemented. Direct reading monitoring shall be required during all contingency action activities. The specific type of direct reading will be dependent on the hazard/s identified when the Contingency Plan is implemented. The Contractor shall develop direct reading instrumentation and time weighted average air sampling dependent on the tasks required. The purpose of the sampling is to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel. Minimum initial requirements for the program are delineated below. Available site information shall be reviewed and the exposure monitoring/air sampling program shall be expanded and/or revised for submittal as part of the SSHP.

3.3.3.5 Safety Procedures, Engineering Controls, and Work Practices

The SSHP shall describe the standard operating safety procedures, engineering controls and safe work practices to be implemented if the Contingency Plan is implemented. These shall include, but not be limited to, the following:

a. General site rules/prohibitions (buddy system, eating, drinking, and smoking restrictions, etc.):

b. Work Permit Requirements: Excavation, hot work, confined space, etc.

c. Material Handling Procedures

d. Materials Transfer Safety

e. Drum and Container Handling: Procedures and Precautions (opening, sampling, overpacking) prepared in accordance with 29 CFR 1926 Part 65 and EM 385-1-1.

f. Confined Space Entry Procedures

g. Fire Protection and Prevention

h. Excavation and Trench Safety

i. Guarding of Machinery and Equipment

j. Hazard Communication

k. Engineering Controls

l. Signs and Labels

3.3.3.6 Personal Protective Equipment Requirements

In accordance with CFR 29 Part 1910 Section .120 (g)(5) and CFR 29 Part 1926 Section .65 (g)(5), a written Personal Protective Equipment (PPE) program which addresses the elements listed in that regulation, and which complies with respiratory protection program requirements of CFR 29 Part 1910 Section .134, shall be included in the Contractor's Site Safety and Health Plan. The SSHP shall detail the minimum PPE ensembles (including respirators) and specific materials from which the PPE components are constructed. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions. Only respirators approved by NIOSH shall be used. On site personnel shall be provided with appropriate personal protective equipment if the Contingency Plan is implemented. The PPE section of the SSHP shall include site-specific procedures to determine PPE program effectiveness and for on site fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE. The following requirements shall be addressed in the PPE section of the SSHP.

a. The Safety and Health Manager shall establish appropriate levels of protection for a contingency action based on review of historical site information, existing data, an evaluation of the potential for exposure (inhalation, dermal, ingestion, and injection) during each task, past air monitoring results, and a continuing safety and health monitoring program. The Contractor's Health and Safety Manager shall provide a copy of the initial level of protection to the Contracting Officer for approval if the Contingency Plan is implemented.

b. The Safety and Health Manager shall also establish action levels for upgrade or downgrade in levels of PPE from the following specified minimum levels of protection. Protocols and the communication network for changing the level of protection shall be described in the SSHP. The PPE reassessment protocol shall address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc. The following items constitute minimum protective clothing and equipment ensembles to be utilized during a contingency action:

1. Level D

Steel Toe and Sole Work Boots
Boot Covers for the Specific Chemical
Work Clothes, including Shirts and Long Pants
Hard Hats
Safety Glasses (Splash Goggles or Face Shields if there is a Splash Hazard)

2. Modified Level D

Steel Toe and Sole Work Boots
Boot Covers for the Specific Chemical
Work Clothes, including Shirts and Long Pants
Hard Hats
Safety Glasses (Splash Goggles or Face Shields if there is a Splash Hazard)
Inner and Outer Gloves for the Specific Chemical
Disposable Coveralls for the Specific Chemical

3. Level C

Steel Toe and Sole Work Boots
Boot Covers for the Specific Chemical
Work Clothes, including Shirts and Long Pants
Hard Hats
Inner and Outer Gloves for the Specific Chemical
Disposable Coveralls for the Specific Chemical
Full Face Respirator with Chemical Specific Cartridges

4. Level B

Steel Toe and Sole Work Boots
Boot Covers for the Specific Chemical
Work Clothes, including Shirts and Long Pants
Hard Hats
Inner and Outer Gloves for the Specific Chemical
Disposable Coveralls for the Specific Chemical
Air Supplied Respirator With Escape Provisions

3.3.3.7 Site Control Measures

In order to prevent the spread of contamination and control the flow of personnel, vehicles, and materials into and out of a contingency action area, site control measures shall be established if the Contingency Plan is implemented. The SSHP shall include procedures for the implementation and enforcement of safety and health rules for all persons on the site, including employers, employees, outside Contractors, government representatives, and visitors. The Contractor shall be responsible for the following site control requirements if the Contingency Plan is implemented.

a. Initial anticipated work zone boundaries shall be established by the Health and Safety Manager. Utilizing this guidance, work zone boundaries (exclusion zone, including restricted and regulated areas; contamination reduction zone; and support zone) and access points shall be established and the boundary delineations shall be included on drawings and provided to the Contracting Officer. As work progresses and field conditions are monitored, work zone boundaries may be modified with approval of the Contracting Officer. Work zones shall be clearly identified and marked in the field (using fences, tape, signs, etc.). A site map, showing work zone boundaries and locations of decontamination facilities, shall be posted in the on site office. Work zones shall consist of the following:

1. Exclusion Zone (EZ): The exclusion zone is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Entry into this area shall be controlled and exit may only be made through the CRZ.

2. Contamination Reduction Zone (CRZ): The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas shall be separate and unique areas located in the CRZ.

3. Support Zone (SZ): The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from hazardous waste operations. The Support Zone shall be secured against active or passive contamination. Site offices, parking areas, and other support facilities shall be located in

the Support Zone.

b. A separate log of personnel visiting, entering, or working in the contamination reduction or exclusion zone shall be maintained for each area identified under the Contingency Plan. The log shall include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable), and personal protective equipment utilized. Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they shall show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and shall fill out the Certificate of Worker or Visitor Acknowledgment. This visitor information, including date, shall be recorded in the log. A copy of a Contractor-generated certificate of worker/visitor acknowledgement shall be completed and submitted to the Contracting Officer for each visitor or each employee allowed to enter contamination reduction or exclusion zones, following the example certificate at the end of this section.

c. Site security shall be provided. Temporary fencing shall be placed around the contamination reduction and exclusion zones. The fencing shall clearly separate the areas of the site which contain hazardous waste or suspected hazardous waste. Signs shall be printed in bold large letters on contrasting backgrounds. Signs shall be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

3.3.3.8 Personal Hygiene and Decontamination

Personnel entering the Exclusion or Contamination Reduction Zones or otherwise exposed or subject to exposure to hazardous chemical vapors, liquids, or contaminated solids shall adhere to the following personal hygiene and decontamination provisions. Decontamination shall be performed in the CRZ prior to entering the Support Zone from the Exclusion Zone. Chapter 10.0 of NIOSH Pub No. 85-115 shall be consulted when preparing decontamination procedures. A detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers shall be submitted as part of the SSHP. Employees shall be trained in the procedures and the procedures shall be enforced if the Contingency Plan is implemented. Persons disregarding these provisions of the SSHP shall be barred from the site. Available site information shall be reviewed and the Health and Safety Manger shall determine the decontamination procedures. The procedures shall be presented to the Contracting Officer for approval. The SSHP shall contain a generic decontamination procedure which can be used with the suspected hazards on the site.

3.3.3.9 Equipment Decontamination

If the contingency Plan is implemented, vehicles and equipment used in the EZ shall be decontaminated in the CRZ prior to leaving the site. The procedures for decontamination of vehicles and equipment shall be addressed in the SSHP. The procedures shall address disposal of contaminated products and spent materials used on the site, including containers, fluids, oils, etc. Any item taken into the EZ shall be assumed to be contaminated and shall be inspected and/or decontaminated before the item leaves the area. Vehicles, equipment, and materials shall be cleaned and decontaminated prior to leaving the site. Construction material shall be handled in such a way as to minimize the potential for contaminants being

spread and/or carried offsite. Prior to exiting the site, vehicles and equipment shall be monitored to ensure the adequacy of decontamination.

3.3.3.10 Emergency equipment and First Aid Requirements

The SSHP shall describe the emergency and first aid equipment to be available if the Contingency Plan is implemented. The following items, as a minimum, shall be maintained onsite and available for immediate use:

a. First aid equipment and supplies approved by the consulting physician.

b. Emergency eyewashes and showers which comply with ANSI Z358.1.

c. Emergency-use respirators. For rescue purposes, 2 positive pressure self-contained breathing apparatus (SCBA) shall be supplied. These shall be dedicated for emergency use only and maintained onsite in the Contamination Reduction Zone.

d. Fire extinguishers with a minimum rating of 20-A:120-B:C shall be provided at site facilities and in all vehicles in the exclusion zone.

3.3.3.11 Emergency Response Procedures

An Emergency Response Plan, that meets the requirements of CFR 29 Part 1910 Section .120 (l) and CFR 29 Part 1926 Section .65 (l), shall be developed and presented as a section of the SSHP. In the event of any emergency associated with a contingency action, the Contractor shall, without delay, alert all onsite employees that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the Contracting Officer; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Employees that are required to respond to hazardous emergency situations shall be trained in how to respond to such expected emergencies. The plan shall be rehearsed regularly as part of the overall training program for site operations. The plan shall be reviewed periodically and revised as necessary to reflect new or changing site conditions or information. The following elements, as a minimum, shall be addressed in the plan:

a. Pre-emergency planning. The local emergency response agencies shall be contacted. Agencies to be contacted include local fire, police, and rescue authorities with jurisdiction and nearby medical facilities that may be utilized for emergency treatment of injured personnel.

b. Personnel roles, lines of authority, communications for emergencies.

c. Emergency recognition and prevention.

d. Site topography, layout, and prevailing weather conditions.

e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).

f. Specific procedures for decontamination and medical treatment of injured personnel.

g. Route maps to nearest prenotified medical facility. Site-support

vehicles shall be equipped with maps. At the beginning of project operations, drivers of the support vehicles shall become familiar with the emergency route and the travel time required.

h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the Contracting Officer and/or their alternates).

i. Criteria for initiating community alert program, contacts, and responsibilities.

j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies shall be immediately notified. In addition, the Contracting Officer shall be verbally notified immediately and receive a written notification within 24 hours.

3.3.3.12 Inspection Requirements

If the Contingency Plan is implemented, the SSHO shall perform daily inspections of the exclusion zone and the work in progress to ensure compliance with EM 385-1-1, the Safety and Health Program, the SSHP and other occupational health and safety requirements of the contract, and to determine the effectiveness of the SSHP. Procedures for correcting deficiencies (including actions, timetable and responsibilities) shall be described in the SSHP. Follow-up inspections to ensure correction of deficiencies shall be conducted and documented. Daily safety inspection logs shall be used to document the inspections, noting safety and health deficiencies, deficiencies in the effectiveness of the SSHP, and corrective actions taken. The SSHO's Daily Inspection Logs shall be attached to and submitted with the Daily Quality Control reports. Each entry shall include the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special safety and health issues and notes, and signature of preparer. In the event of an accident, the Contracting Officer shall be notified according to EM 385-1-1. Within 2 working days of any reportable accident, an Accident Report shall be completed on ENG Form 3394 and submitted.

EXAMPLE CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGMENT

PROJECT NAME CONTRACT NO.
PROJECT ADDRESS
CONTRACTOR'S NAME
EMPLOYEE'S VISITOR'S NAME

The contract for the above project requires the following: that you be provided with and complete formal and site-specific training; that you be supplied with proper personal protective equipment including respirators; that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you.

I HAVE READ, UNDERSTAND AND AGREE TO FOLLOW THE SITE SAFETY AND HEALTH PLAN FOR THIS SITE.

Name Date

--- ---

FORMAL TRAINING: I have completed the following formal training courses that meet OSHA's requirements:

Date Completed

40 hour: ....._____
8 hour supervisory:....._____
8 hour refresher:....._____

SITE-SPECIFIC TRAINING: I have been provided and have completed the site-specific training required by this Contract. The Site Safety and Health Officer conducted the training. _____

RESPIRATORY PROTECTION: I have been trained in accordance with the criteria in the Contractor's my Employer's Respiratory Protection program. I have been trained in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair policy. _____

RESPIRATOR FIT-TEST TRAINING: I have been trained in the proper selection, fit, use, care, cleaning, and maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in the Contractor's my employer's Respiratory Program and have received a satisfactory fit. I have been assigned my individual respirator. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time._____

CERTIFICATE (continued)

MEDICAL EXAMINATION: I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray. A physician made determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's industrial hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

were no limitations to performing the required work tasks;

were identified physical limitations to performing the required work tasks.

Date medical exam completed

Employee's Visitor's Signature _____ Date _____

Printed Name _____

Social Security Number _____

Contractor's Site Safety and Health Officer Signature _____

Date _____

Printed Name _____

Social Security Number _____

-- End of Section --

PHASE II

DIVISION 2 – SITE WORK

02101	Special Scheduling
02102	Clearing, Grubbing, and Stripping
02103	Utility Relocation (TO BE PROVIDED BY AMENDMENT)
02104	Design Build Gatewell 6A
02160	Excavation Support Systems
02200	Relief Well Construction
02220	Demolition
02228	Rockfill
02251	Chemical Grouting Gatewell 9 Excavation
02316	Excavation, Trenching, and Backfilling for Utilities Systems(TO BE PROVIDED BY AMENDMENT)
02318	Controlled Low Strength Backfill (Flowable Fill)
02331	Levee Construction and Earthwork
02370	Soil Surface Erosion Control
02371	Wire Mesh Gabions
02378	Geotextiles Used as Filters
02380	Stone Protection
02431	Pipe Jacking Concrete Pipe
02456	Steel H-Piles
02457	Steel 16-inch and 24-inch Diameter Pipe Piles
02464	Metal Sheet Piling
02465	Auger-Placed Grout Piles
02466	Drilled Foundation Caissons (Piers)
02510	Water Distribution System
02531	Sanitary Sewers
02630	Storm-Drainage System
02700	Asphaltic Concrete Intermediate Leveling and Surface Courses (Central Plant Hot Mix)
02721	Rigid Base Course
02722	Graded, Crushed Aggregate Base Course and Rigid Base Course
02731	Aggregate Surface Course
02748	Bituminous Tack and Prime Coats
02754	Concrete Pavements for Small Projects
02760	Field Molded Sealants for Sealing Joints in Rigid Pavements
02763	Pavement Markings
02821	Fencing
02840	Vehicle Barriers and Construction Signs
02921	Seeding
02945	Tree Protection
02955	Turf Establishment
02990	Detour and Haul Road

SECTION 02101

SPECIAL SCHEDULING
08/00

PART 1 GENERAL

1.1 SCOPE

This section covers special scheduling and general guidelines for performance of the work.

1.2 GENERAL

The work shall consist of the various types of construction indicated on the drawings, and shall be scheduled to minimize disruption of normal usage of streets, railroads, and utilities. Changes in the schedules, sequences, and methods of construction specified herein must be approved in writing by the Contracting Officer's Representative (COR) and any affected third party.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES.

SD-01 Data

Plans of Operations; GA-RE; GA-EC.

Detailed plans of operations shall be submitted for specific phases of the work as specified hereinafter and for other phases when required by the COR. See also SECTION: EARTHWORK.

1.4 COOPERATION BETWEEN CONTRACTORS

Construction work on other contracts will be under way concurrently with this contract. The obligations of the Contractor under this contract include jointly planning, scheduling, and coordinating the work on a cooperative basis with the other Contractors involved in order to minimize delays and interferences. Contracts to perform the work described hereinafter will be underway concurrently with this contract. This may not be a conclusive list.

Contracting Agency	Description of Work
Corps of Engineers Contractor	Missouri River Levee System Quindaro Levee and Stoplog Gap (L-385 Phase I)
Burlington Northern Santa Fe Railroad	Required contract track work at Q1 and Q3

1.5 PERMITS

1.5.1 Highway Permits

The Contractor shall obtain the necessary construction permits from the Missouri Highway and Transportation Department, District 4, for all work adjacent to Highway 9, Highway 69, and Highway 71 (NW Platte Road, and I-635. The points of contact are Mr. Brian Wrisinger at (816) 622-0414 and Mr. Norman Beeman at (816) 622-0413.

1.5.2 Other Permits

The Contractor shall obtain all other necessary permits for work within project limits including, but not limited to, NPDES permit, dredging permit, the City of Riverside permits and Burlington Northern Railroad permits.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

Stockpiling of excavated materials and construction materials shall be minimized and shall be contained within the construction limits, provided adequate safety of the excavation slopes is maintained in all construction areas. Burlington Northern Railroad, Kansas City Power & Light Company, Southwestern Bell, American Cable Vision, Williams Energy, AT&T, Missouri Cities Water Company, Kansas City Water Services, MO-Gas Energy, Intercontinental Corporation, Williams Gas, City of Riverside, Williams Communications, Kansas City Water & Sewer Department, Prologis Corporation, and other appropriate agencies shall be contacted for coordination and relocation of utility lines adjacent to the levee, floodwall, pump stations, rolling gate and stoplog closures.

City streets and roads and parking areas within the project limits shall be kept free of dirt, mud, rock, or other material spilled or dropped from equipment. Dust shall be controlled by sprinkling, washing, sweeping, or other methods as approved by the COR. In using the roads, the Contractor shall conform to any regulations or weight restrictions required by the City of Riverside, Missouri Highway and Transportation Department, and the weight restrictions in the Special Clauses.

3.2 WORK IN VICINITY OF EXISTING UTILITIES

The Contractor shall notify the owners of existing underground utilities (gas, sewer, water, electricity, cable television, and telephone, etc.) a minimum of 180 days prior to commencing required work in the vicinity of the utilities. The location of all affected utilities should be verified and all necessary relocations and alterations completed prior to commencement of work in a particular area or as described on the drawings. A 180-day notice shall be given by the Contractor to the Williams Company prior to requiring utilities to be relocated. Contacts for the utility work are as follows:

AGENCY	CONTACT	TELEPHONE NO.
Burlington Northern Railroad	Mr. Mark Anderson	1-913-551-4434
Kansas City Power & Light Co.	Mr. Pat O'Malley	1-816-556-2200
	Mr. Morris Wilson	1-816-719-1019
Southwestern Bell	Mr. Ken Morse	1-816-231-1243
American Cable Vision	Mr. Brad Robinett	1-816-358-8833
Williams Pipeline		
(Energy Services	Mr. Jeff Johnson	1-918-599-4077
(Gas Pipeline Central	Mr. Douglas Bonner	1-918-573-3856
(Communication)	Mr. Donnie King	1-918-573-4208
AT & T	Mr. B.J. McDermott	1-816-521-2127
MCI World.com	Mr. John Golnf	1-816-521-2127
Missouri Cities Water Co.	Mr. Dave Williams	1-816-741-2991
Kansas City Water & Pollution Control		1-816-274-1755
KPL-Gas Service	Mr. Dan Shaw	1-816-221-4600
Intercontinental Corporation	Mr. Clare Kuhlman	1-816-741-0700
City of Riverside, MO	Mr. David Blackburn, City Adminstrator	1-816-741-1544
Kansas City Water Services Department	Mr. Brian Schroeder	1-816-513-2203
Riverside Quindaro Levee District	Mr. Bob Gieseke	1-816-741-6844
Dig Rite		1-800-DIG-RITE
Kansas City Water Services Dept	Mr. Robert Williamson	1-816-231-8373
City of Riverside Engineer	Mr John Jackson	1-816-741-3239
City of Parkville Water Dept.	Mr. Mike Gray	1-816-741-2992
Mo. Dept of Transportation	Mr. Brian Wrisinger	1-816-622-0414
Prologis Corporation	Ms. Rebecca Denault	1-816-505-4231

3.3 FLOODWALL CONSTRUCTION

The construction area shall be completely fenced around Gatewell 8 excavation to prevent the public from entering the construction area. The accessway shall be kept safe, and free of dirt, debris, and construction materials at all times.

Stockpiling of excavated materials and construction materials shall be minimized and shall be contained within the construction right-of-way, provided adequate safety of the excavation slopes is maintained in all construction areas.

The two storage hangar buildings owned by the City of Riverside shown to be removed shall be relocated through coordination between the Contractor and the City of Riverside.

The Contractor shall notify the City of Riverside and Kitterman Plastics Corporation a minimum of 90 days prior to commencing work on areas currently occupied by hangar structures, storage areas, fenced areas, parking and/or loading areas adjacent to the left side of the Riverside Levee and Floodwall approximately from Station 23+00 to

Station 36+00. The Contractor shall notify Prologis Corporation a minimum of 180 days prior to commencing work on the Riverside Levee and Floodwall approximately from Station 23+00 to Station 36+00. The Contractor shall not use right of way in these above locations as a storage area for construction materials or equipment. In addition, the Contractor shall yield the right of way for all Prologis and Kitterman Plastics properties to trucks accessing the businesses. The Contractor shall be required to move equipment and vehicles from the right-of-way as necessary to permit access and egress to the Prologis and Kitterman Plastics properties during construction.

3.4 LEVEE CONSTRUCTION

The Contractor must build the new levee up to the level of protection of the existing levee before removing the existing levee.

3.5 PROLOGIS CORPORATION - TRACT 187 (located east of Tract 144)

The Contractor shall notify Prologis Corporation a minimum of 90 days prior to commencing work on areas currently occupied by parking and/or loading areas adjacent to the left side of the Riverside Levee from Station 52+00 to Station 62+00 (Prologis Tract 187). The Contractor shall not use right of way in this location as a storage area for construction materials or equipment. In addition, once storm drainage and other associated work has commenced adjacent to the Prologis paved areas, the maximum duration of the storm drainage work at this location shall not exceed 30 days, including weekends but excluding legal holidays and rain days. The construction of the drainage work in this area shall be divided into two segments as follows: (I) all drainage work within the east half of easement tract shall not exceed 15 work days including weekends but excluding legal holidays and rain days and (II) all drainage work within the west half of the easement tract shall proceed immediately after the construction within the east half of the easement tract and shall not exceed 15 work days, including weekends but excluding holidays and rain days, so that one-half of the easement tract will be available to the Grantor for use for general vehicular access, parking, loading and unloading during the time in which the Contractor is performing the drainage work on the other half of the easement tract. After completion of the construction of the drainage work on the other half of the easement tract, the Contractor shall not use such portion of the easement tract for staging or the stock piling of materials, except when necessary to repair, maintain or replace the drainage improvements and then only for the minimum time reasonably necessary to effect such repair, maintenance or replacement and in a manner which shall minimize interference with the Grantor's use of the easement tract.

The Contractor shall restore the surface of each half of the easement tract on Prologis property Tract 187 within the aforesaid 15 day period of performance of the drainage work thereon so that the portion of the easement tract upon which the work has been completed is available to the Grantor for general vehicular traffic, parking, loading and unloading. The Contractor shall (I) restore the paved area within the easement tract to the grade of the existing pavement adjacent to the north and of a thickness equal to or better than the pavement removed, and (II) repair and restore the concrete pads for trash containers within the easement tract which were

damaged or removed as part of the installation and construction of the drainage improvements. All of the work described in clauses (I) and (II) shall be performed by the Contractor within ten days after all of the drainage work is completed within the entire easement tract; provided, however, after completion of the drainage work on each half of the easement tract and before completion of the restoration of the paved area, the paved area shall be compacted and prepared in such a manner as to withstand use by heavy trucks even under inclement weather conditions. Following completion of the drainage work within the entire easement tract, the Contractor shall provide the Grantor at least (5) business days advance notice of all non-emergency inspections, maintenance and repairs of the drainage improvements which would necessitate access and use of the easement tract. The Contractor shall promptly restore any disturbance of, and repair any damage to, the paved area caused by any activities of the Contractor, including inspections, maintenance and repairs to the drainage improvements.

The easement shall not be construed to grant any right to the District's Contractor which shall in any way interfere with the safe and unrestricted use by Grantor of the easement tract, provided that Grantor shall not use nor attempt to use the easement tract in such a manner as would interfere with the proper, safe and continuous use, repair, replacement and maintenance of the drainage improvements and specifically, Grantor shall not build on or over the easement tract any structure which may interfere with the use, repair, replacement and maintenance of the drainage improvements by the District.

The Contractor shall have the right to remove the existing fence upon the right-of-way tract for the purpose of construction of the L-385 Levee Project Improvements (the "Levee Project Improvements") upon the construction thereof. Upon commencement of the Parking/Access Work (defined below), the Contractor shall have the right to remove any other structures or improvements located upon the right-of-way tract for the purpose of construction of the Levee Project Improvements; provided, however that the Contractor shall notify Grantor a minimum of ninety (90) days in advance prior to beginning construction of the Levee Project Improvements on the right-of-way tract and shall complete such construction subject to other time limitations herein imposed, within 3 years of the date construction commences on the right of way tract; provided, however, and notwithstanding the foregoing, once any work (other than the removal of the fence and use of the Levee Access Area) begins within the Parking/Access Area ("Parking/Access/Access Area Work") the maximum duration of such construction by the District shall be 30 consecutive days, including weekends but excluding legal holidays and rain delay days with the construction of the Parking/Access Area Work to be divided into two segments as follows: (i) all Parking/Access Work within the east half of Parking/Access Area shall proceed first and shall not exceed fifteen (15) work days, including weekends but excluding legal holidays and rain days and (ii) all Parking/Access Work within the west half of Parking/Access Area shall proceed immediately after the construction within the east half of the Parking/Access Areas and shall not exceed fifteen (15) work days, including weekends but excluding legal holidays and rain days, so that one-half of the Parking/Access Area will be available to the Grantor for use for general vehicular access, parking, loading and unloading during the

time in which the Contractor is performing the Parking/Access Work on the other half of the Parking/Access Area; provided, further, the District shall have the full 3 years to remove and replace the fence as well as a permanent right to use the Levee Access Area for access as herein permitted. The Contractor shall (i) restore the paved area within the Parking/Access Area to the grade of the adjacent pavement to the north and such restored pavement shall have a thickness equal to or better than the pavement removed, and (ii) restore and/or repair the concrete pads for trash containers within the Parking/Access Area which may be damaged or removed as part of the installation and construction of the Parking/Access work. All of the work described in clauses (i) and (ii) ("Restoration Obligations") shall be performed by the Contractor within ten (10) days after all of the Parking/Access Work is completed within the entire Parking/Parking/Access Area; provided, however, after completion of the Parking/Access Work on each half of the Parking/Access Area and before completion of the restoration of the paved area, the paved area shall be compacted and prepared in such a manner as to withstand use by heavy trucks even under inclement weather conditions. After completion of the construction of the Parking/Access Work on each half of the Parking/Access Area, the Contractor shall not use such portion of the Parking/Access Area for staging or the stock piling of materials except when necessary to maintain, repair or replace the Drainage Improvements and then only for the minimum time reasonably necessary to effect such repair, maintenance or replacement and in a manner which shall minimize, to the extent reasonably possible, interference with Grantor's use of the easement tract.

Upon the Contractor's removal of such fence (from approximately Station 56+00 to Station 62+00), with the exception of the easterly 20' of Tract 187 which will be designated as shown as a levee access area and as such will not require temporary fencing, the Contractor shall place a temporary demarcation showing the location line of the fence and the portion of the right of way lying south thereof, which temporary demarcation shall remain in place during construction of the Levee Project Improvements except while the Parking/Access Area Work is being performed. The temporary demarcation shall consist of the temporary installation of posts connected by rope or other similar materials. Prior to the completion of the construction of the Levee Project Improvements on the L-385 Levee Project, the Contractor shall, unless otherwise directed by the State of Missouri, replace the fencing removed to construct the Levee Project Improvements with new fencing, which new fencing shall be of the same type as the fencing removed unless otherwise directed by the State of Missouri.

Temporary fencing will not be required for the duration of storm drainage work on Tract 187.

In addition to any rights granted hereunder, Grantor also grants, bargains, sells and conveys to the District the right to use the property described as "Levee Access Area" for the purpose of access to the Levee Project Improvements. The use of the Levee Access Area by the District or its Contractor for access shall not materially interfere with the use of the Parking/Access area by Grantor, its tenants or others using the Parking/Parking/Access Area with permission of Grantor.

Following completion of all of the construction of the Levee Project

Improvements on the entire L-385 Levee Project, the Contractor shall provide Grantor at least five (5) business days advance notice of all non-emergency inspections, maintenance and repairs which would necessitate the District's access and use of the Parking/Access Area (other than the Levee Access Area) provided that such access and use will in no way materially interfere with the use of Parking/Access Area by Grantor, its tenants or others using the Parking/Access Area with permission of Grantor.

The Contractor shall coordinate activities and work together with the Grantor to minimize any disturbance caused the other.

PARKING/ACCESS AREA DESCRIPTION

PERMANENT RIGHT-OF-WAY DESCRIPTION

All that part of Lots 3 and 4, RIVERSIDE BUSINESS PARK, a subdivision of land in the City of Riverside Platte County, Missouri, according to the recorded plat thereof, described as follows:

Beginning at the Southeast corner of said Lot 3; thence South 89^54'18" West, along the South line of Lots 3 and 4, a distance of 615.04 feet; thence North 00^28'48" East, along the West line of the grantors land, a distance of 10.07 feet; thence North 89^54'47" East a distance of 603.20 feet; thence North 00^26'04" East a distance of 20.00 feet; thence North 55^46'15" East a distance of 14.44 feet to a point on the East line of said Lot 3; thence South 00^29'59" West, along the East line of said Lot 3, a distance of 38.09 feet to the Point of Beginning. Containing 6,450.38 square feet or 0.1481 acres, more or less.

The bearings used in this description are based upon the South line of said Lots 3 and 4 being South 89^54'18" West.

RIGHT-OF-WAY CONVEYANCE LEVEE ACCESS AREA

All that part of Lot 3, RIVERSIDE BUSINESS PARK, a subdivision of land in the City of Riverside, Platte County, Missouri, according to the recorded plat thereof, described as follows:

All that part of the Southeast corner of said Lot 3 that lies East of the Southerly prolongation of the Easterly edge of an existing parking lot and South of the Easterly prolongation of the southerly edge of said existing parking lot.

Said tract of land being approximately the South 13.50 feet of the East 20.00 feet of said Lot 3.

Containing approximately 270 square feet, more or less.

3.6 PROLOGIS CORPORATION - TRACT 144 (located back of the floodwall, vicinity of approximate Sta 31+00 to 35+00)

The Contractor shall notify Grantor a minimum of 90 days in advance prior

to beginning of the project improvements of the right-of-way tract and shall complete such work within 3 years after commencing work on the right-of-way tract.

Following completion of the construction of the levee project improvements on the right-of-way tract, the Contractor shall repave the parking/access area, affected by construction, to a condition as least as good and a thickness as least as great as existed prior to the commencement of the levee project improvements of the right-of-way tract which shall be on a grade level with the pavement adjacent to the parking/access area. Following completion of all of the construction of the levee project improvements on the entire L-385 Levee Project, the Contractor shall provide the Grantor at least five (5) business days advance notice of all non-emergency inspections, maintenance and repairs which would necessitate the access and use of the Parking/Access Area provided that such access and use will in no way materially interfere with the use of the Parking/Access Area by Grantor, its tenants or others using the Parking/Access Area with permission of Grantor.

When the Contractor begins work in the temporary construction easement, the Contractor shall have the right to remove any structures or improvements located upon the temporary easement tract, including paved surfaces within the area of the temporary easement tract for the purpose of undertaking the temporary construction work; provided, however, that the Contractor shall notify the Grantor a minimum of 180 days in advance prior to beginning the temporary construction work on the temporary easement tract (which notice shall state the date that such Work is anticipated to actually begin); provided, further, the Contractor shall diligently perform its work within the temporary easement tract in order to maintain temporary access to the north most bay door on the west side of the building located on the parcel ease of and adjacent to the temporary easement tract. Following construction of the temporary construction work, the Contractor shall restore and repair damage caused by construction to the paved surface by repaving to a condition as least as good and a thickness as least as great as existed prior to the commencement of the temporary construction work on the easement tract which shall be on a grade level with the pavement adjacent to the easement tract. The duration of the temporary construction work on the temporary easement tract shall not exceed ninety days from the commencement of such work, including weekends but excluding legal holidays and rain days.

At the conclusion of 90 days, including weekends but excluding legal holidays and rain days, from beginning the temporary construction work or upon final completion of all temporary construction work, whichever date is earlier, this temporary construction easement shall terminate.

3.7 RELOCATIONS

The Contractor shall not perform work on the Dry Basement, Ramsey and/or Master Auto Tech properties for a minimum of 180 days following the date of the contract award. These two properties will be relocated following the contract award.

3.8 CLOSURE CONSTRUCTION

The sequence of construction carried out for the various closure structures shall be as follows:

a. Complete construction of levee to full height in the vicinity of the closure monoliths a minimum of 45 days prior to installation of auger cast piles for the closure, storage, and associated floodwall monoliths.

b. Construct closure, storage, and associated floodwall monoliths in accordance with staging sequences as shown on the drawings and outlined hereinafter.

c. Construct I-wall transitions.

3.9 SCHEDULE OF WORK AT THE CLOSURE STRUCTURES (Q1 AND Q3) ON RAILROAD RIGHT-OF-WAY

3.9.1 General

Burlington Northern Railroad will provide flagmen and protective services and devices as required for the protection of railroad traffic and operations during the performance of the work by the Railroad and the Contractor. Burlington Northern Railroad will be responsible for the removal and installation of temporary and permanent track work and the installation of a crossing at Q1.

3.10 Plans of Operations

Construction shall be performed in accordance with approved detailed plans of operations submitted by the Contractor for each of the two locations: Closure gaps Q1 and Q3. Duplicate copies of the detailed plans of operations shall be submitted to the railroad company and to the COR a minimum of 45 days in advance of the commencement of work.

3.11 PROTECTIVE SERVICES

The Contractor shall reimburse Burlington Northern Railroad and Intercontinental Corporation for providing any protective services, including flagmen and devices which may be required for protection of railroad traffic and operations due to operations of the Contractor. Upon completion of the work in the areas where protective services are required, the Government shall be furnished itemized invoices showing the actual costs billed to and paid by the Contractor in full for protective services. The Government will adjust the contract lump sum price for "Protective Services" under clause CHANGES of the CONTRACT CLAUSES to the actual total amount paid by the Contractor under this item.

3.12 Q0 CLOSURE GAP STAGING

The work shall be performed as shown.

3.13 Q1 and Q3 CLOSURE GAP STAGING AND CONSTRUCTION REQUIREMENTS

The work on Q1 shall be performed as shown.

The work at Q3 shall be performed as shown.

The Contractor shall coordinate with Intercontinental and Burlington Northern Sante Fe Railroad and establish a construction schedule six months in advance of Q1 and Q3 construction. Q1 and Q3 construction will be done concurrently to minimize disruption to the Railroad. The Contractor shall submit the proposed schedule to the contracting officer's representative (COR) for review and approval prior to Q1 and Q3 construction. The Contractor shall accommodate minor adjustments of approximately one week to the established commencement of the construction schedule if required by the Intercontinental shipping schedule.

The contractor shall notify all owners of spur lines, between Q1 and Q3 structures, of the scheduled single track operation six months in advance of Q1 and Q3 construction.

To complete the construction of the Q1 closure gap, the Intercontinental spur line shall be temporarily out of service for a duration not to exceed ten weeks.

To permit the construction of the Q1 and Q3 closure gaps, Burlington Northern Sante Fe Railroad will operate on a single live track as shown for a duration not to exceed four weeks. If the Contractor exceeds the four week allowance for single live track operations, he shall be responsible for all liquidated damages in accordance with Section 00800. For inclement weather allowances, see Section 01100, 1.8(d).

The Contractor shall comply with the safety manual and program administered by the Burlington Northern Sante Fe Railroad.

As used in this Section, "Owner" includes Burlington Northern Santa Fe Railroad and other railroad companies using BNSF property at or near the location of the Project and their officers, agents and employees. "Loss" includes loss, damage, claims, demands, actions, causes of action, penalties, costs, and expenses of whatsoever nature, including court costs and attorney's fees, that may result from: injury to or death of persons whomsoever (including, the Owner's officers, agents, and employees, the Levee District's officers, agents, and employees, as well as any other person); and damage to or loss or destruction of property whatsoever (including damage to the roadbed, tracks, equipment, or other property of the Owner, or property in its care or custody).

It is understood that the safety and continuity of the Owner's railroad operations are of the utmost importance and, so that such operations shall be adequately safeguarded, the Contractor, in the performance or work related to the Project or any time thereafter in the construction, shall not obstruct, interfere with, or delay the maintenance or operations of Railroad Facilities without the prior written approval of the Owner. The Contractor shall exercise like precaution and will

diligently supervise its own work and that of its contractors to the end of all work carried on in proximity to the Owner's existing or relocated Railroad Facilities and shall not obstruct, interfere with, or delay the operations of the Owner. The Contractor shall notify the Owner in advance, prior to performing work on or adjacent to the Owner's existing and relocated right-of-way and tracks, so as to enable the Owner to furnish flagging and such protective services at the Owner deems necessary to ensure the safety of its railroad operations.

The Contractor shall provide the Owner with a Railroad Protective Insurance Policy in the amount of $2,000,000 for any Work, at any time, that occurs on the Owner's property or within 50 feet of the railroad tracks. Should such damage result in disruption of the Owner's facilities, the Owner shall have the right to make immediate repairs and the Contractor shall be obligated to compensate the Owner the actual cost of said repairs together with actual loss resulting therefrom. The Government shall assume no liability for damages to persons, property, or any other liability that is paid to Owner by insurance carried by any Government contractor. The existence or the non-existence of insurance shall not limit the Contractor's liability.

The Contractor shall obtain and maintain, at its own expense, and shall require its subcontractors to obtain and maintain in force during construction the following insurance:

1. Commercial General Liability Insurance, to include contractual liability products/completed operations, against claims arising out of bodily injury, illness and death and from damage to or destruction of property of others, including loss or use thereof, including liability of the Owner, Contractor, and all subcontractors, and each of them with minimum limits for bodily injury and property damage of $2,000,000 for each occurrence with an aggregate of $6,000,000. This policy shall contain a "Waiver of Transfer Right endorsement to waive any right of recovery that the insurance company may have against the Owner because of payments made for bodily injuries or property damage.

2. Business Automobile Policy Insurance, including owned, non-owned and hired vehicles with minimum limits for bodily injury and property damage of $1,000,000 per occurrence on vehicles used on railroad property.

3. Workers' Compensation Insurance or coverage as required under the Workers' Compensation Act of the State of Missouri. The policy shall include occupational disease to require statutory limits, employer's liability of $1,000,000 to include FELA, if appropriate, and "all states" endorsement.

The Owner shall be a named additional insured under the above liability policies.

4. In addition to the insurance requirements of 1-3 above, the Contractor will be required to furnish the Owner a Railroad Protective Liability Insurance policy issued in the name of the Owner with a limit of Two Million Dollars ($2,000,000) for bodily injury and property

damage per occurrence and an aggregate of Six Million Dollars ($6,000,000) when work performed by the Contractor under this agreement is to be upon Owner's right-of-way or within 50 feet of the Owner's railroad tracks.

The policies are to be primary and not contributory and shall release Owner as to payments of any earned premium. All insurance certificates provided to the Contractor must be satisfactory to the Owner as to insurance carriers covering the risks and bear a cancellation clause providing that such insurance may not be canceled, amended, allowed to lapse until the expiration of at least thirty (30) days advance written notice to Owner.

Prior to entry on the Owner's property, the Contractor shall furnish to the Owner for approval the original certificate of Insurance, the original policy, or other satisfactory evidence that all the insurance, which the Contractor is obliged to furnish under the foregoing provisions, has been obtained and is being maintained.

The Contractor shall indemnify, defend, and hold harmless the Owner from any loss which is due to or arises from:

1. The prosecution of any work contemplated by the Contract, including the installation, construction, maintenance, repair, renewal, modification, reconstruction, relocation, or removal of the Closure Structures or any parts thereof; or

2. The presence, operation, or use of the Closure Structures or contents escaping therefrom, except to the extent that the loss is caused by the sole and direct negligence of the Owner. The Government shall assume no liability for any damages to persons, property, or any other liability for which Owner is compensated for by insurance carried by any Contractor of the Government. The existence or the non-existence of insurance shall not limit the Contractor's liability under this Agreement.

Work to be done by the Contractor shall be done concurrently with work to be done by the Owner. The Owner shall perform all track work, provide all track material and labor (including any flagging and/or protective services), and install signal work for the Project as shown on plans. The Contractor will provide the Owner with a minimum of 90-days notice to proceed with work and order material for the Project. The Owners work shall include:

(i) completing the following described work within a 24-hour period: removal and replacement of approximately 50 linear feet on each side of the Closure Structure crossing centerline for each section of the existing North and South Main Tracks through the closure monoliths. The Owner shall not be required to remove or replace more than 440 linear feet in total.

(ii) completing subsequent phases of work to be done by the Owner within the schedule established by the Government. This scheduled work to be done by the Owner includes, but is not limited to, removing the

North Main Track and the South Main Track at the Closure Structures and installing new North Main Track and South Main Track.

(iii) performing all work by Owner concurrently with the work performed by the Government and the Government's contractor.

(iv) providing the Government ten (10) six-hour windows, without train operations, for constructing the Closure Structures.

The Contractor shall provide adequate insurance to cover all that part of the cost and expense of extraordinary maintenance (hereinafter referred to as "deferred construction") of said facilities that can be attributed to failure of subgrade, settlement, and consolidation of sub ballast, or roadbed, or any combination thereof, that are incurred during the period commencing immediately following completion of the work by the Contractor and ending five years thereafter. These deferred construction costs shall include reimbursement of the extra costs, in excess of normal maintenance costs, of maintaining embankments and that portion of said tracts above subgrade in accordance with acceptable maintenance standards, and will include cost of maintaining proper alignment, proper surface, and use of ballast and other necessary materials. The work of such deferred construction shall normally be performed by the Owner either with its own forces or through responsible contractors employed by it. In the event major construction is required for deferred construction, the Government may accomplish such major items by contract, subject to approval and inspection by the Owner, all at the expense of the Contractor. If said work involves Railroad Facilities, said work will be done in accordance with the Owner's then-current labor union contract.

The Contractor shall not go on or within 50 feet of Owner's railroad tracks, unless and until reasonable notice is provided to the Owner and a flagman or flagmen are provided to watch for trains, except as required to transverse the existing railroad crossings including Intercon Drive, Mattox Road, Van de Populiere Road, and Northwest Argosy Parkway. The flagmen shall be employees of the Owner, and shall be acting under the direction and control of said Owner's superintendent, or his designated representative. The Contractor shall follow and obey all directions and instructions of said flagman or flagmen while on or about the Owner's property.

The Contractor's's machinery and materials shall be kept off the Owner's premises. There shall be no crossing of the Owner's tracks except at existing, open public crossings.

The Government shall, however, assume no liability for any damages to persons, property, or any liability that is compensated for by insurance carried by any Government contractor. The existence or the non-existence of insurance shall not limit the contractor's liability.

The Contractor shall obtain all necessary permits, licenses, and authority for the work to be performed by the Government and shall provide in its contracts with third parties that they shall obey and

abide by all applicable laws, regulations, ordinances, and other rules of the United States of America, of the State, or political subdivisions thereof wherein the work is done or any of other duly constituted public authority.

In the event of a slide or other occurrence caused by the work on the Project that adversely affects the Owner's train operations, and if the occurrence occurs on an area that is being constructed by the Contractor and is precipitated by acts or omissions of the Contractor, the Contractor shall take immediate corrective action with the consent of the Government's Contracting Officer Representative, at the Contractor's expense.

THE CONTRACTOR WILL BE PLACED ON NOTICE THAT FIBER OPTIC, COMMUNICATIONS, CONTROL SYSTEMS, AND OTHER TYPES OF CABLES MAY BE BURIED ON OWNER'S PROPERTY. Before beginning work, the Contractor shall telephone Owner's Communications Network Control Center at 1-800-533-2891 (a 24-hour number) to determine if cable systems are buried on Owner's property to be used by Contractor. The Communications Network Control Center will contact the appropriate personnel to have cables located and make arrangements with Contractor as to the protective measures that must be adhered to prior to commencement of any work on Owner's property. In addition to the liability terms elsewhere in this Section, the Contractor shall indemnify, defend, and hold Owner harmless against and from all cost, liability, and expense whatsoever (including, without limitation, attorney's fees and court costs and expenses) arising out of or in any way contributed to by (1) any act or omission of Contractor, its subcontractors, agents and/or employees, (2)any injury to or death of any person employed by or on behalf of any telecommunications company, and/or its contractor, agents and/or employees, on Owner's property, and/or (3) any claim or cause of action for alleged loss of profits or revenue by, or loss of service by a customer or user of such telecommunication company or companies.

3.14 Q3A CLOSURE GAP STAGING

The work shall be performed as noted on the drawings C36A4 through C36A5.

3.15 WEST PLATTE BRIDGE REMOVAL

The Contractor shall not remove the bridge until the Line Creek Channel work downstream is complete and R1 sandbag gap, to be constructed by others, is complete and associated roadways are reopened to traffic.

3.16 R1A CLOSURE GAP STAGING

The work shall be performed as noted on the drawings C-59 through C-62B.

3.17 R2 CLOSURE GAP STAGING

The work shall be performed as noted on the drawings C-63 through C-67. The auger cast piles shall be constructed prior to the construction

of the drilled piers for this gap. The top of rock shown on sheet C-65 is based on site borings; however, the seismic study indicated that the rock surface may be higher in the area of the storage monolith. If this condition is found, the Contracting Officer shall be immediately notified and drilled piers shall be used in lieu of auger cast piles as directed.

3.18 LINE CREEK RELOCATION

The Contractor shall maintain Line Creek flow at all times during the relocation of Line Creek. In addition, the relocation of Line Creek Channel shall be constructed concurrently with levee construction.

3.19 RED-X AND CRAZY HARRY'S

The Contractor shall not perform work including, but not limited to, levee construction, drainage system installation and excavation on the Red-X and/or Crazy Harry's properties from June 15th until July 6th, and from December 20th through January 2nd at Crazy Harry's.

3.20 QUINDARO PUMP STATION

Before removal of the existing drainage ditch and structure, the pump station must be fully constructed from the inlet to the downstream end of the outlet ditch, backfilled, and tested. The existing drainage ditch and the inlet/outlet drainage structures shall remain fully operational during construction of the pump station.

3.21 ACCEPTANCE OF THE CLOSURE SYSTEMS

Closure systems shall be fully operational before acceptance. Approval and acceptance of closure systems shall be based on the performance of the closure system during closure and subsequent opening. All coordination involved to conduct performance tests at each gap are the responsibility of the Contractor. The closure system shall not be accepted until all operation and maintenance data are accepted and approved.

3.22 TRACTS 51 AND 57 (Vicinity of Argosy Casino, approximate Sta 184+00 to 205+46 Landward and Riverward of Levee)

All work performed on this property and the scheduling of same shall be coordinated with Missouri Gaming Commission and Argosy Casino. The Contractor shall not use the parking lot, shown in the construction right-of-way, approximate Stations 200+00 to 204+00, for construction materials or equipment. Also, the Contractor shall yield to Argosy patrons during construction in this area.

3.23 TRACTS 125 AND 126 (Approximate RB Sta 9+00 to 13+00)

The Contractor shall not disturb the existing large elm tree located along Vivion Road or block access to the nursing home.

3.24 TRACTS 137 AND 151 (Riverside Levee, Approximate Sta 13+00 to 16+00)

The Contractor shall provide notice and coordination of scheduling prior to working in this construction right-of-way landward of the levee. Access to the building will not be cut off by the construction easement. Some

parking will be available at all times. The Contractor shall not physically disturb the building itself.

3.25 TRACT 141 (Left Bank Line Creek Floodwall Approximate Sta 25+00 to 27+20)

The Contractor will notify the owner (Kitterman Plastics) 90 days in advance of commencement of work in the construction right-of-way area. The Contractor shall not use the construction right-of-way area as a storage area for construction materials or equipment. During construction, the Contractor shall yield the right of way to vehicles accessing the business and shall move its equipment and vehicles from this construction right-of-way area as is reasonably practicable and as reasonably necessary to permit access and egress to the owner's property. After construction of levee and floodwall improvements on this property, but prior to completion of the levee project, the Contractor shall not use this construction right-of-way area as a storage area for construction materials or equipment; and while accessing this area, the Contractor shall not unreasonably interfere with access or truck loading operations of the owner.

3.26 TRACTS 142 AND 148 (Vicinity of Left Bank Line Creek Floodwall, Approximate Sta 27+20 to 29+00)

Easement rights go to the fence line of the Tank Farm area only, and do not cross over into the Tank Farm area. Neither the fence nor the curb under the fence shall be disturbed. Although the security fence may be moved, it shall be maintained around the property.

3.27 TRACT 200A (R2 - Rolling Gate Vicinity Riverward, Approximate Sta 81+00 and North of West Platte Road)

Access to owner's property will not be cut off by the temporary construction easement. The Contractor shall not physically disturb the restroom and storage building.

-- End of Section --

SECTION 02102

CLEARING, GRUBBING, and STRIPPING
08/00

PART 1 GENERAL

1.1 GENERAL

The work covered by this section consists of furnishing all submittals, labor, equipment, materials, and efforts necessary to perform clearing, grubbing, and stripping as defined for this project. The work covered by this section also includes filling where clearing, grubbing, and stripping has occurred. The work within this section does not apply to clearing, grubbing, and stripping for utility relocations performed by others.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES.

SD-01 Data

Plan of Operations; GA-RE.

A detailed plan of operations+++ shall be submitted for the Contracting Officer's Representative (COR) approval. No work shall be initiated until the plan of operations has been approved by the COR. As a minimum the plan of operations submittal for clearing, grubbing, and stripping shall include the scheduling, safety, staging layout and limits, sequencing of operations, structure removal, extent in advance of construction, maintenance of areas completed, protection of adjacent facilities, erosion control, coordination with other construction activities, stockpiling, and method or methods of disposal of cleared, grubbed, and stripped materials.

Disposal Plan(s); GA-RE.

A plan shall be submitted identifying the method or methods of disposal of cleared and grubbed items. Items subject for appropriate off-site disposal should be indicated as such in the plan. Disposal whether on site or off site shall not violate the requirements of this contract and Federal, state, and local regulations. The submittal shall address all required permits necessary for this work and outline the Contractor's application and acquisition of the required permits.

SD-18 Records

Disposition; GA-RE.

The Contractor shall submit for filing with the COR all agreements,

permits, and disposition of materials' locations.

1.3 DISPOSITION WITHIN THE LEVEE'S CRITICAL AREA

Work within the L-385 levee's critical area shall not violate Federal levee criteria and will be subject to COR approval. The critical area shall be defined as from the river or tributary to a distance 500 feet landward of the L-385 levee. Criteria for construction is included on the Local Protection Section's web pages at http:/www.nwk.usace.army.mil/Local_Protection/guidance.html.

1.4 MERCHANTABLE TIMBER

Merchantable timber remaining within the areas to be cleared on or after the date of award of this contract may be disposed at the Contractor's discretion but the disposition shall not violate the requirements of construction documents.

1.5 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

Clearing, grubbing, and stripping shall be completed in accordance with the construction documents to include the approved plan of operations. Where deviation from the approved plan is necessary, the deviation shall first be submitted to the COR as an amendment to the plan of operations and not begun until approved by the COR. The Contractor shall execute clearing, grubbing, and stripping so as to protect all adjacent areas against damage. The Contractor shall not interfere with use, or safe passage to and from these areas. Any damage caused by these operations shall be repaired to the satisfaction of the COR at no additional cost to the Government.

3.2 CLEARING

3.2.1 General

In general, clearing shall consist of removal and disposal of all above grade items within the limits indicated hereinafter and items specifically identified within the construction documents for removal. Features identified to remain in-place shall be protected from damage. Items that may require clearing include, but are not limited to, structures, trees, brush, rubbish, stone, metal, stumps, downed timber, abandoned foundations, fencing, general debris, and other objectionable obstructions as directed. Trees, stumps, brush and other vegetation shall be cut flush with the

ground and grubbed out as directed in hereinafter. If regrowth of vegetation or trees occurs after clearing and before construction begins or within an ongoing construction area, the Contractor shall clear the area at no additional expense to the Government. All items shall be cleared in such a manner as to safeguard employees and others and to avoid damage adjacent features.

3.2.2 Felling of Trees

Felling and removal of trees shall be performed in such manner as to avoid damage to trees left standing, to existing structures and those under construction, and with due regard for the safety of employees and others.

3.2.3 Fence

Fencing and fence posts shall be cleared and disposed. Removed fence shall be replaced to the limits shown on the drawings. The post portion below grade shall be grubbed.

3.2.4 Clearing Limits

Complete clearing shall be conducted within the limits of excavation, fill, or general construction and 10 feet contiguous to the work but not to exceed the limits of the construction right-of-way. Clearing outside these limits shall not occur unless prior approval or direction is provided by the COR. Clearing shall also be conducted for features specifically identified for removal.

3.2.5 Inspection

Areas cleared shall be inspected by the Contractor and COR prior to fill, excavation, or general construction. If the area requires clearing due to new growth or the clearing in general is unsatisfactory, then the Contractor, at no expense to the Government, shall clear the area in accordance with the requirements herein.

3.2.6 Disposition of Cleared Materials

In general, disposition of cleared materials shall be completed in accordance with the approved plan of operations. The Contractor shall make a reasonable effort to channel merchantable material into the commercial market and to promote beneficial use of the materials obtained during clearing. Under no circumstances shall cleared materials be disposed within the critical area of the levee (river or tributary to a distance of 500 feet landward of the L-385 levee). Cleared materials shall not be dumped in the river or tributary or stockpiled in flood prone areas. Once materials have been cleared the Contractor shall dispose in accordance with the approved plan of operations. Stockpiles shall only be allowed as necessary for gathering and loading.

3.2.7 Cleared Wood Items

Wooden items cleared shall be disposed of by burning, offsite disposal at an approved facility, chipped, and/or stockpiled for public availability at

an approved site. If burning is selected as the disposition practice, the Contractor shall be responsible for constructing all required facilities; limiting burn hours to those allowed, complying with all Federal, state, and local regulations and permitting practices; and maintaining on hand fire fighting equipment and provide the appropriate training. If burning is elected for use, the Contractor shall coordinate with the City of Riverside, Missouri at 816-741-1544 and the Missouri Department of Natural Resources (MDNR) at 573-634-2436 in obtaining the required permits. The Contractor shall not leave burning areas or areas susceptible to "flaring-up" unattended. If the Contractor elects to utilize chipping practices, the chips shall be removed from the site and hauled to approved sites.

3.3 GRUBBING

In general, grubbing shall consist of removal of objectionable items and materials below grade and the proper backfill and compaction of the cut resulting from the removal within the limits indicated hereinafter. Grubbing shall also be required for items specifically identified for removal. Items or features subjected to grubbing shall include, but not limited to, stumps, buried logs, debris, metal, roots of 1-1/2-inch or larger diameter, and other objectionable matter to a depth of 6 feet below natural ground surface. Grubbing shall also consist of the complete removal of underground structures, pipes, posts, and pavement not specifically indicated to remain that are encountered within the grubbing limits.

3.4 Grubbing Limits

Grubbing shall be completed within the limits of excavation, fill, or general construction and 10 feet contiguous to the work but not to exceed the limits of the construction right-of-way. Grubbing outside these limits shall not occur unless prior approval or direction is provided by the COR.

3.5 Utilities

Utilities shall either be removed or abandoned in-place per the limits and requirements shown on the drawings.

3.6 Pavement

The removal of the existing pavement shall be to the limits shown on the drawings and specified herein. The pavement cut shall be made by a suitable power saw to provide a neat and smooth vertical edge. The equipment shall be tested by cutting a short test length in the area of the pavement structure that will be removed. As soon as the pavement cut is made, the Contractor shall restrict, by barricades as approved by the COR, all vehicle and pedestrian traffic from crossing the cut.

3.7 Inspection

Areas grubbed shall be inspected by the Contractor and COR prior to filling the cut. Grubbing not completed to the requirements herein shall be properly grubbed by the Contractor at no expense to the Government.

3.8 Disposition of Grubbed Materials

Disposition of grubbed materials shall comply with the same requirements of disposition of cleared materials.

3.9 Filling of Cuts Resulting from Grubbing

In general, cuts resulting from grubbing shall be backfilled and compacted with impervious material per the requirements within the Section, "Levee Construction and Earthwork". Deep excavations may utilize the same material type as the undisturbed foundation adjacent the cut and at the same elevation subject to approval by the COR. Lift thickness and compaction requirements shall be determined based on the location of the fill. Fill located within the levee embankment slopes projected (not including the berms) shall be compacted per the requirements of the levee embankment for the appropriate fill type. Fill located outside the levee embankment slopes projected shall be compacted per the requirements of the levee berm for the appropriate fill type. Fill located elsewhere such as for pavement construction shall be per the requirements of the specific installation or construction.

3.10 STRIPPING

In general, stripping shall consist of scraping of the topsoil's upper zone to include light vegetative cover, root system, and organics within the limits indicated hereinafter. Prior to stripping an area, the area shall be cleared, grubbed, and mowed. The mower shall be of a type that shreds the vegetative cover. If regrowth occurs after stripping and before construction begins or within an ongoing construction area, the Contractor shall strip the area at no additional expense to the Government.

3.11 Stripping Limits

Complete stripping shall be completed within the limits of excavation, fill, or general construction and 10 feet contiguous to the work but not to exceed the limits of the construction right-of-way. Stripping outside these limits shall not occur unless prior approval or direction is provided by the COR.

3.11.1 Stripping Within General Construction Areas

Stripping within general construction areas such as levee, berms, pavement, and general fill or construction areas shall be completed no deeper than 6 inches from the ground surface. Stripped areas may be less than 6 inches if the Contractor demonstrates that roots, organic soils, and vegetative cover has been removed. Depths greater than 6 inches shall comply with the requirements of grubbing.

3.11.2 Stripping Within Ponding Area Limits and Structure Excavation Limits

Stripping shall be completed to a depth of 6 inches within the limits of the ponding area and structural excavation. If additional topsoil is needed to cover fill areas such as the levee embankment and berms, an

additional 6 inches may be obtained from the limits of the ponding area and structural excavation for a total of 12 inches. If the lower 6 inch thickness is not needed, then it shall be placed in the appropriate fill zone.

3.12 Inspection

Areas stripped shall be inspected by the Contractor and COR prior to fill, excavation, or general construction. If the area requires stripping due to new growth or the stripping is unsatisfactory, then the Contractor, at no expense to the Government, shall strip the area in accordance with the requirements herein.

3.13 Disposition of Stripped Materials

In general, stripped materials shall be stockpiled and protected and used as topsoil for the fill construction such as levee embankment, berms, and ramps. Excess stripped material, if any, shall be spread within the excavation of ponding areas above the waterline at the time of placement. In the event material is stripped that does not classify as topsoil per the requirements of Section, LEVEE CONSTRUCTION AND EARTHWORK, the material shall be utilized within the appropriate fill zone. Material that does not meet classification requirements for any fill zone, shall be spread within the ponding areas above the waterline at the time of placement.

-- End of Section --

SECTION 02104

DESIGN BUILD GATEWELL 6A
09/01

PART 1 GENERAL

DESIGN-BUILD SCOPE OF WORK FOR THE DEVELOPMENT OF PLANS AND SPECIFICATIONS FOR REVISION OF 66" DRAINAGE STRUCTURE ON LEVEE UNIT L-385.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1	U.S. Army Corps of Engineers Safety and Health Requirements Manual
EM 1110-2-2104	Strength Design for Reinforced-Concrete Hydraulic Structures
EM 1110-2-2902	Test requirements for the pipe, pipe joints and the gatewell

ENGINEERING TECHNICAL LETTERS

ETL 1110-2-307	Flotation Stability Criteria for Concrete Hydraulic Structures
ETL 1110-2-534	Structural Evaluation of Welded Aluminum Guardrails on Civil Works Projects

ENGINEERING REGULATIONS

ER-1110-345-700	Design analysis

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

35 percent Submittal; GA-CG.

The 35% design submittal shall be submitted within 20 calendar days after the pre-design meeting. The 35% submittal shall be used to determine the appropriate structural systems and the layouts that should be designed.

95 percent Submittal; GA-CG.

The 95% design submittal shall be submitted within 30 calendar days after the 35% review conference. The 95% design submittal shall be a complete design analysis that includes a set of drawings and specifications.

Final Submittal; GA-CG.

This submittal shall include project plans, new specifications, and revisions to existing contract specifications. The final submittal shall be complete.

1.3 CONTRACTOR SERVICES.

Work to be accomplished by the Contractor consists of analysis and design, preparation of new contract drawings, and changing existing contract plans and specifications for the work required to provide the System 1 66" gatewell 6A structure for levee unit L-385 Riverside, Missouri. The Contractor shall identify, for approval, the Architecture Engineer (AE) firm for each area of work. The AE firm shall stamp, sign and date all design drawings under their responsible discipline at each design submittal stage.

1.4 DESCRIPTION/PURPOSE OF THE DRAINAGE STRUCTURE REVISION.

The original System 1 gatewell 6A design consists of a concrete structure housing 1 flush mounted 66" sluice gate. When flood conditions are present, the sluice gate provides closure of the RCP sanitary sewer preventing inundation of the levee-protected area. The sluice gate is also temporarily lowered to the closed position during non-flood conditions to facilitate exercise or periodic maintenance activities. The City of Kansas City, Missouri has requested that an alternate means of routing sanitary sewer (bypass) be made available in the event that the 66" sluice gate becomes lodged in the closed position during a non-flood condition. The bypass will allow continued passage of sanitary sewer while repairs to the lodged sluice gate are occurring. The bypass shall be accomplished by revising the existing gatewell 6A design. The revision will include a gated 18" diameter bypass pipe that passes through the gatewell structure and will be connected to the 66" RCP immediately upstream and downstream of gatewell 6A. An additional 66" sluice gate will also be included in the design to prevent the entrance of sanitary sewer into the gatewell interior during sluice gate repair operations. A plan view of the proposed design is shown in Figure 1.

1.5 SPECIFIC WORK TO BE PERFORMED.

A. General: The Contractor shall be responsible for performing all the

analysis and design work, preparing a set of contract drawings, providing new specifications, and reviewing and changing existing contract drawings and specifications to reflect the work specified herein. The Contractor shall not deviate significantly from the design shown in Figure 1 without prior government approval. The final product shall be practical and constructable. The Contractor shall work in close association with the Kansas City District (KCD) Corps of Engineers Design Project Manager.

B. Work Description: Following is a list of the drainage structures and systems included within this design-build scope of work.

1) 66" Drainage Structure - Sta. 2+92 Riverside Levee. The Contractor shall design and develop plans and specifications for construction of gatewell 6A on the System 1 66" RCP sanitary sewer line.

2) Design Analysis. Provide a narrative design analysis for the work specified herein as discussed in paragraph 12.

3) In addition, the Contractor shall design and develop plans and specifications for the gatewell accessories.

1.6 Criteria.

A. Reference Material. The document, "Missouri Levee System Quindaro-Riverside Levees and Structures (Levee Unit L-385)Missouri River, Missouri" 95% Design Documentation Report (DDR), Volume NS1 dated September 2000 provides the design loads and methods of analysis of the original gatewell 6A design. The revised gatewell structure will incorporate the design criteria specified in the above referenced DDR and additional criteria contained herein. The Contractor is responsible for reviewing the original design analysis in the 95% DDR, existing contract plans and specifications, other project pertinent information, Government criteria and requirements, and systems to understand the concept of the levee project, to be aware of design requirements for flood control projects, and to become familiar with the information pertinent to the gatewell 6A revision. Copies of the DDR and the plans and specifications are available in the Kansas City District Office.

B. Specific Criteria. The following requirements and criteria are provided to assist the Contractor. If a specific structural system does not fall within the criteria listed below, the Contractor shall use the appropriate criteria and follow the requirements in paragraph 8. Criteria, references, and instruction necessary to allow for preparation of plans and specifications includes the following:

1). Reinforced Concrete Gatewell. The structural geometry of the reinforced concrete gatewell shall be determined by the Contractor. The Contractor may use the existing gatewell 6A details and Figure 1 as aids in sizing and designing the revised gatewell 6A structure. The gatewell rim elevation remains at 769.10 and the top of base slab elevation is 726.7 +/- as shown on S98 and S81. The gatewell shall be placed on the riverside of the top of the levee. The gatewell shall be placed within the riverside slope and shall be as close to the top of levee as possible. If the gatewell is offset from the top of levee,

access to the top of the gatewell shall be provided. This may include exterior ladder systems. The gatewell shall contain two 66" flush bottom sluice gates and one 18" slide gate. All of these gates shall be operated from the gatewell top slab. Electricity to the gatewell will not be provided. A means of limiting the amount of torque delivered to the sluice gates and slide gate stems shall be incorporated into the design. The 18" sanitary sewer bypass shall be constructed of ductile iron pipe (DIP) material. Areas of the DIP exposed to soil shall be encased in reinforced concrete. The DIP shall connect to the 66" RCP at an angle of 45 degrees horizontal relative to the 66" RCP as shown in Figure 1. The DIP flow line elevation shall match the 66" RCP springline elevation. The Contractor shall perform design and analysis of the gatewell structure and may adjust geometry and layout as necessary to meet the design requirements, but the Contractor shall not adversely impact other features or violate the established right-of-way limits. The Contractor shall coordinate with Government point of contact to ensure location adjustments and structural sizing does not violate hydrologic and hydraulic requirements. The Contractor shall coordinate with the Local Protection Section, contact Richard Bateman, for site location and site layout details for the gatewell structure. Details of the original gatewell structure are shown on contract drawings S80A, S81,S98, and U1. These details may be used to assist in the development of the revised gatewell structure.

3) Loading Conditions. The design loads present on the gatewell structure include those outlined in the fore-mentioned 95% DDR. Loads generated by the 18" bypass revision are to be included into the design also.

4) Strength Design for Reinforced Concrete: Strength design for the reinforced concrete gatewell 6A structure shall be in accordance with EM 1110-2-2104, entitled "Strength Design for Reinforced-Concrete Hydraulic Structures". For the load case of water to the top of levee, the hydraulic load factor may be multiplied by .75 (see equation 3-4 of EM1110-2-2104). Waterstops shall be placed at all construction joints.

5) Gatewell Foundation: The gatewell shall be supported by a H-pile foundation. The H-piles shall be of sufficient strength to support the gatewell structure when full of water and be used as end bearing piles on bedrock material. The typical pile size used for the L-385 project has been an HP14 x 102 but this may vary depending on the specific loading conditions present for this gatewell revision. Any foundation support offered by the H-pile side friction will be assumed to be zero. The bedrock depth is assumed to be approximately 55 feet below the existing ground surface. A company independent of the pile foundation installer shall confirm that the pile foundation is resting on bedrock material. The Contractor shall coordinate with the Local Protection Section, contact Richard Bateman, to obtain the applicable soil parameters and criteria.

6) Flotation Stability: Uplift stability of the gatewell structure shall be checked using ETL 1110-2-307 entitled "Flotation Stability Criteria for Concrete Hydraulic Structures". The uplift force exerted on the gatewell structure will equal the weight of the volume of water

displaced by the gatewell structure. The use of heels at the base of the structure is an acceptable means of aiding against uplift. The flotation stability will be checked under the following operating conditions for a dry gatewell:

a. Normal Operations. The river water surface elevation is 3 feet below top of levee, ELEV. 766.10. The uplift factor of safety is 1.5.

b. Extreme Condition. The river water surface elevation is at top of levee, ELEV. 769.10. The uplift factor of safety is 1.1.
The Contractor shall coordinate with the Structural Design Section (contact Marvin Parks) if more specific guidance is needed to perform the flotation stability analysis. In addition, the Local Protection Section has a document entitled Guidance for Work Proposed Near or Within a Federally Constructed Flood Control Project that describes the recommended loading conditions and safety factors for uplift stability. This document can be found at http://www.nwk.usace.army.mil/Local_Protection/Levee.html.

7) RCP Details: Details shall be provided for bell and spigot wall fittings at the RCP/gatewell interface. When RCP intersects a gatewell, two half-lengths of pipe shall be provided at the structure/pipe interface. Concrete cradles shall be provided at the gatewell/pipe interface. The RCP shall bear on concrete cradles as shown on S81.

8) Material Properties: The concrete and reinforcement material properties shall be in accordance with the properties listed on sheet S1 of the contract plans. The Government will provide the soil material properties. The soil material properties shall be coordinated with the Local Protection Section (contact Richard Bateman).

9) Miscellaneous Steel Items: The completed gatewell design shall also include the following miscellaneous metal items: access hatches, ladder rungs, sluice gates and accessories, and guardrails. Access hatches shall be designed for 100 psf uniform load, prevent the venting of sanitary sewer odors and facilitate removal of both sluice gates from the gatewell. Grates shall not be allowed due to venting of sanitary sewer. Access into the gatewells and the ladder design shall comply with Section 21 and Appendix J of EM 385-1-1 entitled US Army Corps of Engineers Safety and Health Requirements Manual. The guardrails shall be aluminum members. The design of the guardrails shall comply with ETL 1110-2-534 entitled Structural Evaluation of Welded Aluminum Guardrails on Civil Works Projects. Sluice gates shall be designed per the manufacturers recommendations and loading as required by Corps criteria. Refer to contract drawings S72,S80 and S80A for gatewell metal details.

10) Testing Requirements. The AE shall provide a specification or revise the existing specifications to address test requirements for the gatewell structure. Test requirements for the pipe, pipe joints and the gatewell are outlined in EM 1110-2-2902. The specifications should clearly indicate the testing required, the method of testing and the procedures for verifying and approving the tests. Testing requirements shall also be provided for the sluice and slide gates. Test

requirements for the sluice and slide gates shall be in accordance with the manufacturers recommendations.

1.7 GENERAL CONSIDERATIONS.

The Contractor shall be responsible for identifying all issues affecting design, analysis and construction of the gatewell structure. The Contractor shall be responsible for resolving all the issues identified.

1.8 RELEASE OF INFORMATION.

The Contractor shall not publicize nor release in any manner information or data in regards to projects on which they may be working or negotiating with this office, nor discuss prior to public release by this office, a project, any future program, or any planning with anyone not directly concerned with the design of the project. Any inquiries in regard to these matters shall be referred to the Contracting Officer or District Project Manager. Classified information obtained from this office shall be treated in accordance with instructions in regard to such matters.

1.9 COORDINATION OF PLANS AND SPECIFICATIONS.

The Contractor shall check and coordinate all structural project data prior to all submittals. Deficiencies, ambiguities, conflicts and inconsistencies shall be rectified prior to submittal of documents. The letter of transmittal shall certify that all documents have been checked and coordinated prior to submittal and shall be signed by a principal of the AE firm assigned by the Contractor. All computations shall be dated, initialed, titled and include the initials of the person who checked the calculations. The AE shall clarify inconsistencies in the design, and correct any errors in the design prior to construction or any errors that arise during construction. The KCD Corps of Engineers shall review the work of the AE. Any design change or revision to the contract plans or specifications required due to changed field conditions or AE proposals requires review and approval by the KCD Corps of Engineers.

1.10 SUPPLEMENTAL CRITERIA.

The list of "Civil Works Criteria for Structural and Geotechnical Work" located in Appendix B, and the guidance and criteria listed herein is intended to serve as a minimum standard for the Contractor in the preparation of a proposal for professional services that will satisfactorily meet design and construction standards for the proposed project. If the criteria listed in this scope are not applicable to the design, the Contractor shall be responsible for determining the appropriate criteria. Any criteria conflicts or changes shall be submitted in writing to the Government Project Manager for resolution. Additional criteria specific to preparation of the contract drawings, specifications, and design analysis are furnished for the Contractor as described in the Kansas City District Architect-Engineer Instruction Manual. If the criteria mentioned in Appendix B or this scope is in conflict with the criteria presented in the Kansas City District Architect-Engineer Instruction Manual, the criteria in Appendix B and this scope shall govern. Electronic copies of the criteria are located at

http://www.hnd.usace.army.mil/techinfo/. If the criteria are not available in electronic format, paper copies may be obtained from the Kansas City District storeroom (816-426-3330).

1.11 DRAWINGS.

All drawings shall be prepared in accordance with the Kansas City District Architectural-Engineer Instruction Manual. Design criteria and referenced drawings furnished by the Government are intended to serve as a minimum standard for the Contractor in the preparation of acceptable working drawings and specifications.

1.12 USE OF COMPUTER-AIDED DESIGN AND DRAFTING (CADD) SYSTEMS.

A. Requirements. Computer-Aided Design and Drafting (CADD) shall be required for this project. The Contractor shall be responsible for delivering the drawings in the latest available version of Intergraph Corp., Microstation native format (.dgn), adhering to guidance and criteria listed in the Kansas City District Architectural-Engineer Instruction Manual except that drawing standard shall be as indicated in paragraph D below. The Government will provide the seed file and the drawing border to be used.

B. Files. The Contractor shall be responsible for returning to the District electronic files that were created by the Contractor and files modified from existing source material supplied by the District. All electronic files shall be fully compatible with the latest version of Intergraph Corp., Microstation native format (.dgn). The CADD data shall be delivered on an IBM compatible Compact Disc (CD). All drawings shall be legible and easily readable when reproduced at half-scale. The full-size drawing size shall be 28" by 40".

C. Translation. The District will not be involved in any translation process. The District will only accept the final product suitable for full operation on the target system (latest available version of Intergraph Corp., Microstation).

D. Standards. The drawing standards used shall comply with the Tri-Service A/E/C CADD Standards Manual latest Release available at http://tsc.wes.army.mil.

1.13 SPECIFICATIONS.

The specifications for the project have been assembled. The Contractor shall be responsible for revising the existing set of specifications to reflect the work performed herein. If additional specification sections need to be added, the Contractor shall prepare the specifications using Corps of Engineers Standard Guide Specifications. The specifications shall be prepared in accordance with the Kansas City District Architect-Engineer Instruction Manual and the guidance provided herein.

A. New Specifications: New specifications shall be prepared using the latest version of Specsintact. SpecsIntact technical assistance is available by phone Monday through Friday from 8:00 AM to 4:30 PM EST

(voice mail messages may be left after hours).
Phone (321) 867- 8800
Monday through Friday from 8:00 AM to 4:30 PM EST
Fax (321) 867-1444
E-mail SpecsIntact@ksc.nasa.gov
Web Page http://si.ksc.nasa.gov/SpecsIntact

Required specification submittal data

- Table of Contents and Indices
- Schedule and Phasing Requirements
- Sheet & drawing numbers, title and date for each drawing
- Site or job peculiar items limiting work
- Submittal Registers (list of submittal requirements)

The Contractor shall complete the Title And Location and Specification Section blocks and columns c through p of ENG Form 4288, Submittal Register, dated July 96. It is necessary to provide a minimum of one sheet of ENG Form 4288 for each specification section. No more than one submittal should be put on a line. Blank forms are available upon request. The Contractor shall incorporate the revised specifications into the contract specifications and furnish complete, typed, final-form specifications for review. The district will provide the existing contract specifications to the Contractor on 3-1/2 inch diskette or CD.

B. Revisions to Existing Specifications: The Contractor shall revise the existing specifications by providing comments indicating the additions or changes that are required. The comments shall identify the specification section, page and paragraph that are to be revised and indicate the required additions or changes. The Contractor's review of the existing contract specifications shall include the table of contents and indices, schedule and phasing requirements, sheet & drawing numbers, title and date for each drawing, site or job peculiar items limiting work, and submittal registers (list of submittal requirements).

1.14 DESIGN ANALYSIS.

The design analysis shall be prepared in accordance with the information provided within this scope of work, and the guidance provided in the Kansas City District Architect-Engineer Instruction Manual. The design analysis shall be prepared for incorporation into the DDR prepared by Kansas City District. The Contractor shall coordinate the design analysis format with the Structural Section to allow for incorporation into the DDR. The final design analysis shall reflect review comments and development of the final design. Revising by submitting only a design analysis supplement is acceptable for the Final Submittal only. The design analysis shall be prepared in accordance with ER-1110-345-700. The design analysis shall be written format on 8½"x 11" paper. The design analysis may be produced using the latest version of Microsoft Word for all narrative information. Calculations maybe electronically produced and printed or hand written.

1.15 SUBMITTAL REQUIREMENTS.

All submittals are to be sent by commercial overnight delivery service, Postal Service Express Mail or couriers. Distribution of the 95% and final design submittals shall be made by the Contractor directly to the Government Project Manager. The distribution shall include the following final design materials: (15) half size drawings, (3) full size drawings, and (15) sets of specifications.

A. Letter of Transmittal. A letter of transmittal identifying the submission and listing material being submitted should accompany each submission. The letter shall be referenced to the project by title, number and location.

B. Partial Submittal. Partial submittal will not be accepted. Resubmittal of incomplete or rejected submittal shall be at no additional cost to the Government.

C. Final Submittal. The Final Submittal of the contract drawings and the specifications and final design analysis shall be transmitted by registered or guaranteed mail. If no changes were made between the 95% submittal and the final submittal, a statement to that effect shall be submitted.

1.16 CONTRACTOR PROJECT SUBMITTAL (TITLE I SERVICES).

The Contractor will be required to make three submittals, (1) a 35% design submittal, (2) a 95% design submittal, and (3) a corrected final design submittal. The AE shall complete the design work and services as follows in accordance with the requirements of this scope of work:

A. Pre-design Meeting. The Contractor shall attend a Pre-design meeting within 30 calendar days after the notice to proceed. The meeting will allow the AE and the US Army Corps of Engineers to discuss the aspects of the project.

B. 35 percent Submittal. The 35% design submittal shall be submitted within 20 calendar days after the pre-design meeting. The 35% submittal shall be used to determine the appropriate structural systems and the layouts that should be designed. The 35% design submittal shall include the following:

1) Design Analysis. The design analysis shall include calculation for all the loads on the drainage gatewell. The analysis shall include the following:

a) Written Description. A brief narrative describing the references, design loads, assumptions, methods of analysis, structural systems proposed and design issues. The general format for the write-up is as follows:

(1) Design Loads. The water loads, uplift loads, soil loads, gate force loads, and dead loads on the various drainage structures and systems shall be given. State safety factors and criteria used.

(2) Proposed Systems. This section shall include a complete description of the gatewell drainage structure. The drainage structures and systems do not have to be fully designed, but the systems should be developed enough to determine if they are fundamentally sound, practical and constructable. Constructability issues shall be addressed.

(3) References. List applicable technical design criteria sources.

b) Calculations. Provide preliminary design calculations for the gatewell structure including uplift and flotation factor of safety. Provide sketches of typical connections between primary structural members. Document references used for loading, analysis and design.

c) Computer Programs. If the Contractor uses a computer program to perform any analysis or design, the Contractor shall provide a narrative about the program. The narrative shall describe what the program does, what assumptions the program makes, what parameters are required by the program, a description of the input data and a description of the output data. In addition, the AE shall provide any calculations that were required to prepare the input data.

2) Drawings. Drawings shall be drawn to illustrate the proposed structural systems. The drawings shall be drawn to scales that result in drawings that can be read when reduced to half size. Generally, when site plans are included on a drawing for reference and orientation, they are drawn to 1" = 10' or 1/8" = 1'. Details, sections, plans and elevations are drawn to scales that range from ¼" to ¾".

The drawings shall include, but not be limited to the following:

-Plan of the gatewell structure.
-Typical sections of the gatewell structure.
-Typical details of the gatewell structure.

The structural drawings in electronic media shall be submitted in accordance with the requirements of paragraphs 9 and 10.

C. 35% Review Conference. The Contractor shall attend a 35% review conference within 30 calendar days after the 35% submittal.

D. 95 percent Submittal. The 95% design submittal shall be submitted within 30 calendar days after the 35% review conference. The 95% design submittal shall be a complete design analysis that includes a set of drawings and specifications. This submission shall include:

* New Drawings and Revised Drawings
* New Specifications and Comments for Revised

Specifications
* Checked design analysis
* Draft Submittal Register for New Specifications
(Eng Form 4288)

1) Drawings. The drawings shall be submitted as required in paragraphs 9 and 10.

2) Specifications. Completed new specifications for construction of the gatewell structure shall be submitted if needed. Prior to this submittal the Contractor shall identify which new specifications are required. Specifications shall be prepared as required in paragraph 11. Comments indicating revisions to the existing specifications shall be provided.

3) Design Analysis. Design analysis shall be as required in paragraph 12 and as indicated within this paragraph. The design analysis shall be complete and shall include the following:

(a) Design Loads. The water loads, uplift loads, soil load, dead loads, gate loads and other loads on the gatewell shall be given. State safety factors and criteria used.

(b) References. List applicable technical design criteria sources.

(c) Special Considerations. This section shall include a discussion of any special problems or concerns regarding the analysis or detailing of gatewell 6A. State how the design or proposed construction techniques have been addressed and resolved.

(d) Calculations. State the design loads for each part of the gatewell structure. Provide sketches of all the connections between all structural members. In addition sketches of the foundation systems and anchorage systems shall be provided.

(e) Computer Programs. If the Contractor uses a computer program to perform any analysis or design, the Contractor shall provide a narrative about the program. The narrative shall describe what the program does, what assumptions the program makes, what parameters are required by the program, a description of the input data and a description of the output data. In addition, the AE shall provide any calculations that were required to prepare the input data.

C. 95% Review Conference. The Contractor shall attend a 95% review conference within 20 calendar days after the 95% submittal.

D. Final Submittal. This submittal shall include project plans, new specifications, and revisions to existing contract specifications. The final submittal shall be complete. This submittal shall be submitted within 20 calendar days following the 95% review conference. The Contractor shall furnish the following:

* 3 Signed original full-scale prints of contract drawings
* 3 copies of the full-scale prints of contract drawings

* 15 half size drawings.
* 15 hard copies of the specifications.
* 15 copies of the IBM compatible CD containing the new CADD drawings
* 15 copies of the IBM compatible CD containing new specifications
* 15 copies of the IBM compatible CD containing the revisions to the existing specifications.
* 15 copies of the Design analysis supplement (including all updates)
* 3 copies of the Updated Submittal registers for new specifications (Eng Form 4288)

Format of the submittal shall be in accordance with the criteria established in this scope of work.

1.17 GENERAL REQUIREMENTS AND STANDARDS.

A. OSHA Regulations. The Contractor shall be responsible for full compliance with regulations of the Occupational Safety and Health Act of 1970 and for the design of the project to preclude violations to said act from occurring as a result of the design. If at any time during the design of the drainage systems it becomes apparent that a violation may exist as a result of the design, the Contractor shall notify the Contracting Officer in writing requesting consultation to resolve the possible violation.

B. Site Inspection. The Contractor is responsible for making the necessary field visits to assess existing conditions and to obtain such detailed information as is required to complete the design. Discrepancies noted during the site inspection will be made immediately known to the Corps' Project Manager.

C. Site Survey. The Government has available site plans and surveys. This shall be coordinated with the Local Protection Section, contact Richard Bateman.

D. Review Conferences. Personnel familiar with all aspects of the work submitted shall represent the Contractor. The Contractor shall be responsible for taking notes and preparing the minutes for all reviews. Review notes including a list of annotated review comments shall be prepared in typed form and the original furnished to this office, for concurrence and distribution. These minutes shall include the date, place and a list of attendees, including organization and telephone numbers. Comments made during the review conference, or decision affecting criteria changes, must be recorded in the basic conference notes. The conference notes should document any augmentation of written comments. Written comments presented by attendees shall be attached to each report with the conference action noted. Conference action shall be "A" for an approved comment, "D" for a disapproved comment, "W" for a comment that has been withdrawn, and "E" for a comment that has an exception noted. Note comments not incorporated and provide a brief explanation for rejection. All review conferences will be held at the KCD's Office. The AE shall furnish one person from each major discipline involved in the design and the AE Project Manager. The AE Project Manager may act as the representative for anyone of the disciplines for which they are qualified.

E. AE Project Manager. The AE shall assign a principal or key employee to serve as the AE Project Manager. The AE Project Manager shall oversee the coordination of the entire project from this office and obtaining answers to all question from the office during and after the design work. During the prosecution of the work under this contract, the AE shall keep in close liaison with the KCD Corps of Engineers Design Project Manager (PM). All requests made by the Sponsor and other agencies shall be referred to the PM. At appropriate times, representatives of the Contracting Officer may review the progress and technical adequacy of the work. Such review will not relieve the Contractor and AE from performing all contract requirements, except as may be waived by written instruction.

F. Corps of Engineers Project Manager. The following individual will be the Government's Project Manager for the design work specified herein:

Mr. Robert G Dimmitt
PM-CG
U.S. Army Corps of Engineers
601 E. 12th Street
Kansas City, Missouri 64106-2896
Phone: 816-983-3468
FAX: 816-426-6356

1.18 METHOD OF PAYMENT.

A. Title I. The Contractor shall prepare and submit partial pay estimates to the resident office.

For payment for Design and Construction see the Bid Schedule.

1.19 AE RESPONSIBILITY.

A. This contract will remain in force until construction of the project has been completed. During this period, the Contractor will be responsible for the correction of any design errors or deficiencies. Should design changes as a result of revised criteria be required during this period, the Contractor may be required to perform the necessary redesign work. In those instances, the contract will be revised accordingly, including an adjustment in the contract amount.

B. In the event discrepancies, omissions, or other errors in the drawings and specifications are discovered after the final submission, the Contractor shall revise the contract drawings or specifications, prepare sketches and the necessary data. This work shall be accomplished at no additional cost to the Government.

C. Should the Contractor receive any direction or criteria that is not included in this contract that requires additional effort beyond the contract criteria the Contracting Officer shall be notified in writing describing the change(s) impact on the effort.

PART 2 PRODUCTS

NOTE USED

PART 3 EXECUTION

NOTE USED

-- End of Section --

SECTION 02160

EXCAVATION SUPPORT SYSTEMS
10/99

PART 1 GENERAL

1.1 SUMMARY

This Section includes, but is not limited to, the following:

(1) Shoring and bracing necessary to protect existing buildings, embankments, streets, walkways, utilities, and other improvements, as well as excavation, against loss of ground or caving embankments.

(2) Maintenance of shoring and bracing.

(3) Removal of shoring and bracing, as required.

Types of shoring and bracing systems include, but are not limited to, the following:

(1) Steel H-section (soldier) piles.

(2) Timber lagging.

(3) Steel sheet piles. See Section 02460 for addtional requirements pertaining to metal sheet piling systems.

(4) Augercast piles.

(5) Trench boxes.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1997) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 242/A 242M	(1993a) High-Strength Low-Alloy Structural Steel
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 328/A 328M	(1993a) Steel Sheet Piling
ASTM A 490	(1997) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1996) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 502	(1993) Steel Structural Rivets
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(1997) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 618	(1996) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 709/A 709M	(19997a) Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates,

	and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 852/A 852M	(1997) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(1996) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM A992/A992M	(1998) Steel for Structural Shapes for Use in Building Framing

ENGINEERING MANUALS (EM)

EM 385-1-1	(Latest Version at award of contract) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2.1 RELATED DOCUMENTS

Drawings, specifications and general provisions of the Contract apply to this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Layout, Design Drawings, and Calculations; GA-RE

Signed and sealed layout, design drawings and calculations for an excavation support system and other data prepared by, or under the supervision of, a qualified Professional Engineer registered in the State of Missouri. System design and calculations must be acceptable to local authorities having jurisdiction. Information shall be submitted 30 days prior to construction.

1.4 QUALITY ASSURANCE

1.4.1 Engineer Qualifications

A Professional Engineer registered in the State of Missouri, legally authorized to practice in the jurisdiction where the project is located, and experienced in providing successful engineering services for excavation support systems similar in the extent required for this project is required.

1.4.2 Supervision

The Contractor shall engage and assign supervision of the excavation support system to a qualified Professional Engineer foundation consultant, registered in the State of Missouri.

The Contractor shall submit the name of the engaged consultant and qualifying technical experience to the Contracting Officer's Representative (COR).

1.4.3 Regulations

The Contractor shall comply with all codes and ordinances of the governing authorities having jurisdiction.

1.5 JOB CONDITIONS

Before starting work, the Contractor shall verify governing dimensions and elevations, and verify the condition of adjoining properties.

The Contractor shall survey adjacent structures and improvements, employing a qualified registered Professional Engineer; establish exact elevations at fixed points to act as benchmarks; clearly identify benchmarks and record existing elevations; take photographs to record any existing settlement or cracking of structures, pavements, and other improvements; prepare a list of such damages, verified by dated photographs, signed by the Contractor and others conducting investigation; and provide a copy to the COR.

During excavation, the Contractor shall resurvey benchmarks weekly, maintaining an accurate log of surveyed elevations for comparison with original elevations; provide a weekly summary report to the COR; and promptly notify the COR if changes in elevations occur or if cracks, sags, or other damage is evident.

During excavation, the Contractor shall resurvey benchmarks daily. Daily monitoring will be required for Gate well #9 structure only. Movement and defections of Gatewell #9 shoring structure shall be measured daily by the use of strain gages installed on the steel wales, surveying elevations and location of existing adjacent structures, and other methods as may be suitable for monitoring the performance of the temporary shoring structures.

1.6 EXISTING UTILITIES

The Contractor shall protect the existing active sewer, water, gas, electricity and other utility services and structures; shall notify municipal agencies and service utility companies having jurisdiction; and shall comply with the requirements of governing authorities and agencies for protection, relocation, removal, and discontinuing of services.

1.7 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

The Contractor shall provide adequate shoring and bracing materials which will support loads imposed. The materials need not be new, but should be in serviceable condition.

2.1.2 Structural Steel

ASTM A 36/A 36M for other EXCAVATION SUPPORT SYSTEMS applications.

ASTM A 572/A 572M ASTM A992/A992M 50 KSI for Gatewell #9.

2.1.3 Steel Sheet Piles

See Section 02460 for addtional requirements pertaining to metal sheet piling systems.

ASTM A 328/A 328M for other EXCAVATION SUPPORT SYSTEMS locations.

ASTM A 572/A 572M 50 KSI for Gatewell #9.

2.1.4 Timber Lagging

Timber lagging may be of any species of rough-cut, mixed hardwood, nominal 3 inches thick, unless otherwise indicated.

PART 3 EXECUTION

3.1 SHORING

Wherever shoring is required, the Contractor shall locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces, and shall provide a shoring system adequately anchored and braced to resist earth and hydrostatic pressures.

Shoring systems retaining earth on which the support or stability of existing structures is dependent must be left in place at the completion of the work.

3.2 BRACING

The Contractor shall locate the bracing to clear columns, floor framing construction, and other permanent work. If necessary to move a brace, the Contractor shall install new bracing prior to removal of the original brace.

The Contractor shall not place bracing where it will be cast into or included in permanent concrete work, except as otherwise acceptable to the Contracting Officer.

The Contractor shall install internal bracing, if required, to prevent spreading or distortion of braced frames.

The Contractor shall maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

The Contractor shall remove sheeting, shoring, and bracing in stages to avoid disturbance to underlying soils and damage to structures, pavements, facilities, and utilities.

The Contractor shall repair or replace, as acceptable to the Contracting Officer, adjacent work damaged or displaced through installation or removal of shoring and bracing work.

-- End of Section --

02170

RELOCATIONS
03/02

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all submittals, labor, equipment, plant, materials, and all efforts necessary to perform relocations as defined for this project. Relocations of identified structures, pipes, and other features shall be performed by the Contractor as defined herein to design, move, remove and replace, or general alteration as necessary to facilitate construction of the L-385 flood control project and ensure the integrity of the flood control project.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced or where the procedure or information is necessary for performance of the work. The publications are referred to in the text by basic designation only.

KANSAS CITY DISTRICT GUIDANCE AND CRITERIA

KCD GUIDANCE	Guidance for Work Proposed Near or Within a Federally Constructed Flood Control Project; http://www.nwk.usace.army.mil/local_protection/levees

U.S. ARMY CORPS OF ENGINEERS MANUALS/DOCUMENTS

TECH INFORMATION	TECHINFO; http://www.hnd.usace.army.mil/techinfo/index.htm

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section,01330 SUBMITTAL PROCEDURES:

SD-01 Data

Designs; GA-EC

The Contractor shall submit relocations' analysis and design. Where a relocation requires, the Contractor shall also provide a construction contingency plan to ensure safety and continued service.

SD-08 Statements

Plan of Operations; GA-EC

The Contractor shall submit a plan of operations identifying the sequencing of work for completion of all relocations. The plan of operations shall identify the relocations, Contractor responsibility, and the sequencing of activities to include those specific to the relocation and those necessary for construction of the flood control works project (L-385). The plan of operations shall also include a schedule of activities.

Architecture-Engineer Qualifications; GA-EC

The Contractor shall submit the qualifications of the Architecture-Engineer proposed to design the relocations.

1.4 COORDINATION

The Contractor shall coordinate with each relocation owner or operator to establish schedules for respective design and construction to ensure no delays. Immediately upon award the Contractor shall make contact with each know relocation owner to establish a schedule to include in the plan of operations.

1.5 IDENTIFICATION OF WORK

1.5.1 Relocation Schedule

A utility schedule is provided within plan sheet U-9. The Contractor shall refer to this schedule to determine relocation information. Relocations not listed in the utility schedule but identified within the construction documents shall be completed as directed herein.

1.5.2 Relocation Schedule Discrepancies

The Contractor shall verify and correct if necessary all relocation information provided within these construction documents.

1.5.3 Elimination of Relocations

The Contracting Officer reserves the right to not award all or individual relocations as indicated in the bid sheet. If a relocation is not awarded, the Contractor shall coordinate with the owner or operator of the relocation feature to ensure no work conflicts between the relocation and the L-385 construction or to work around the relocation not awarded with arrangements to return and complete the L-385 work as necessary (may be multiple steps) to facilitate the relocation. If a relocation is not awarded, the Contractor shall be responsible for the base L-385 work; work outside the fill and construction limits applicable to the L-385 construction, shall be the responsibility of the relocation owner. Work division limits shall be coordinated with the relocation owner by the Contractor. The Contractor is directed to the paragraph below for information on traverses. In the event a relocation is not awarded, all efforts associated with consequences of the decision shall be at no expense to the Government.

1.5.4 Relocation Schedule Omissions

Relocations discovered during the construction of the L-385 flood control project and not identified within these construction documents shall be brought to the attention of the Contracting Officer upon discovery. The Contractor shall plan their work to stay clear of the discovered relocations until the Contracting Officer provides further direction. An equitable adjustment in contract cost shall be provided to the Contractor if directed to perform a relocation for the discovered feature.

1.6 ARCHITECTURE-ENGINEER QUALIFICATIONS

The Contractor shall submit the qualifications of the Architecture-Engineer proposed to design the relocations. More than one Architecture-Engineering firm may be submitted to address the different design relocations. The Architecture-Engineer shall be a licensed Professional Engineer; have a minimum of 5 years experience with similar project designs for work within or adjacent a Kansas City District Federal urban flood control project with similar features as MRLS L-385; and has experience with the specific relocation such as pressure lines or sanitary sewer force mains.

1.7 POINTS OF CONTACT

The Contractor shall coordinate with the appropriate entities such as Missouri One Call to obtain the point of contact for each applicable relocation. Points of contact identified within these construction documents shall be verified and corrected if appropriate by the Contractor.

1.8 LIMITS OF WORK

Unless otherwise specificied within these construction documents, relocations shall be completed within the limits of the MRLS L-385 permanent right-of-way. Efforts outside the permanent right-of-way but within the construction right-of-way will be as necessary to perform the relocation within the permanent right-of-way.

1.9 LEVEE TRAVERSES

Plan Sheet U-4, "Miscellaneous Utility & Drainage Details" is provided for Contractor information and use where applicable. In addition and in the event others are performing the relocation, the Contractor shall use this detail for structuring their work to facilitate the applicable relocation routing.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

In general, relocations shall be either design complete or design construct. These categories are applied to the schedule provided in the plan sheet. Design complete shall indicate design is completed and the construction work shall be completed by the Contractor or the Contractor's representative. Design build shall require both design and construction to be performed by the Contractor or the Contractor's representative.

3.2 DESIGN COMPLETE

Except where otherwise directed, the Contractor shall complete the relocation per the design requirements within the construction documents.

Submittals shall be per the requirements.

3.2.1 Removed, Abandoned, or Plugged/Filled Relocations

The Contractor shall submit a plan with any applicable design for required removal, abandonment, or plugging/filling of relocations. Submittals shall meet Federal Levee criteria as addressed within the KCD Guidance.

3.2.2 Relocations With Designs

Fence, guard rail, sign relocations, although already designed, shall require design and submittal for installation below grade and shall be in accordance with the KCD Guidance.

3.3 DESIGN-CONSTRUCT

Except where otherwise directed, the Contractor shall complete the relocation per the approved design. Designs shall be in accordance with Federal Levee criteria as found in the KCD Guidance and Tech Information references. Designs shall also meet the relocation owner requirements necessary to maintain the integrity of the service.

3.3.1 Federal Levee Guidance

Federal Levee guidance shall be in accordance with the references KCD Guidance and Tech Infomation. The review emphasis will be on those aspects impacting the flood control works.

3.3.2 Overhead Line Power Poles

Powerpoles' design shall include subsurface details, poles reinforcement, and location to avoid the flood control project and riverward locations (or provide design compensation for impact loads or redirecting river flows).

3.3.3 Electrical Service to Quindaro Pump Station

Quindaro Pump Station will require electrical service routed from a power source to the pump station. The routing will occur on public roads' easements, Phase I right-of-way, and Phase II right-of-way. The Phase II Contractor shall be responsible for coordinating with Kansas City Power and Light for this routing and ensuring both Kansas City Power and Light and Federal Levee criteria is met. The design shall be submitted for Contracting Officer's review. Within 45 days of Phase II award, the Phase II Contractor shall have coordinated with KCPL and the Phase I Contractor to establish a routing (buried or overhead) within the easements and rights-of-way indicated above. Within 30 days of notification, the Phase I Contractor shall complete Phase I construction sufficiently to allow the Phase II Contract route the electrical service.

3.3.4 Submittals

The Contractor shall make as many submittals as necessary to address all relocation owner or operator comments and Contracting Officers' review comments. Submittals shall be all inclusive with investigation, analysis (that includes a hydrostatic hydraulic grade line riverward to landward), design, plans, specifications, and plan of operations. Prior to providing a submittal, the Contractor shall ensure all pertinent aspects of Federal flood control criteria and prior comments have been addressed per

referenced guidance.

SECTION 02200

RELIEF WELL CONSTRUCTION

PART 1 GENERAL

1.1 SCOPE

This section covers construction and installation of relief wells, development of the wells, and pumping tests.

1.2 REFERENCES

AMERICAN WELDING SOCIETY (AWS)

AMSOAWS D1.1	Structural Welding Code, Steel

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

D422	(1963) Method for Particle-Size Analysis of Soils
A312	(1988) Seamless and Welded Austenitic Stainless Steel Pipe
F480	(1989) Specification for Thermoplastic Water Well Casing Pipe and Couplings Made in Standard Dimension Ratio (SDR)
A403	(1988) Wrought Austenitic Stainless Steel Piping Fittings

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Drilling Fluid Additives; GA-EC.
Drilling Fluid Loss; GA-EC.
Drilling Fluid Pit Methods; GA-EC.
Flow Rate Measurement Design; GA-EC.
Discharge Sand Sampler; GA-EC.
Grout Accelerators; GA-EC.

SD-04 Drawings

Drilling Fluid Pit Systems; GA-EC.
Centering Devices; GA-EC.
Surge Block; GA-EC.
Jetting Tool; GA-EC.
Airlift Equipment; GA-EC.

SD-08 Statements

Welder Qualifications; GA-EC.
Well Driller Qualifications; GA-EC.
Sterilization Data; GA-EC.

SD-09 Reports

Particle Size Distribution - Primary Medium Filter Pack; GA-EC.
Particle Size Distribution - Primary Coarse Filter Pack; GA-EC.
Particle Size Distribution - Secondary Filter Pack; GA-EC.
Well Reports and Logs; FIO-EC.

SD-13 Certificates

Riser Pipe Compliance; FIO-EC.
Well Screen Compliance; FIO-EC.

1.4 GENERAL

1.4.1 Contractor Responsibilities:

Contractor responsibilities include drilling and installing the relief wells, relief well development, and pump testing.

1.4.2 Quality Control

The quality control shall be the responsibility of the relief well contractor.

1.4.2.1 General

The relief well installer shall be an established well drilling Contractor, with proven ability and skill in water well installation using reverse-circulation rotary methods. The Contractor shall have a minimum of 5 years of experience performing this type of work. The Contractor shall submit evidence that he has been engaged in the successful completion of water well projects using these methods. Proof of qualifications shall be submitted for approval. The Contractor shall perform all quality control inspections, sampling, and testing of the filter pack material. The Contractor shall take any actions necessary to comply with the Technical Provisions of this specification and submit required reports to substantiate his compliance.

1.4.2.2 Inspection

The Contractor's quality control organization shall be responsible for

observation and control for compliance to technical specifications on all relief well operations including, but not limited to, the following: Survey for location and elevations, materials, drilling method, drilling fluid (type, weight, viscosity), joints, bottom plug, materials storage, well screen well and well pipe assembly and installation, filter pack and grout placement, well cleaning, development, pumps, pump testing, control of drilling fluids and well effluents, restoration of construction area, and safety. The completed wells shall be protected against damage and contamination. The detailed inspection may be assigned to the foreman supervising the work. All well installation work and pumping tests shall be performed in the presence of a Government quality assurance inspector. At least 5 days in advance of the work, the Contractor shall provide the Contracting Officer with a detailed schedule including the dates, shift times, and number of shifts to ensure the availability of adequate Government Quality Assurance (QA) Personnel.

1.4.2.3 Sampling and Testing

The Contractor's quality control organization shall verify that the well pipe and screen conform to the specifications before delivery to the project. The particle-size distribution of the filter pack shall be sampled and tested by the Contractor using U.S. Standard Sieve 1/2-inch, 3/8-inch, #4, #8, #16, #30, #50, #100, and #200. The filter pack shall be sampled from the material stockpiled at the project, tested, and the results submitted to the Government Inspector a minimum of 48 hours before being used in the relief well construction. Filter pack stockpiles shall be clearly marked by means of a sign driven into the ground at each stockpile. When additional material is brought on site, care shall be taken to completely isolate each new load from the existing stockpile until each load is tested and accepted. Stockpiles shall be protected from segregation and contamination by covering with protective tarps. Filter pack which does not meet the appropriate gradation set forth in paragraph, "Filter Pack" and in the drawings shall not be used in relief well construction and shall be removed from the work area. There shall be at least one filter-pack particle-size distribution test for each load of each filter pack, where one load is defined as the quantity of filter pack that one truck or one pup trailer contains. If trucks or trailers are used with capacities larger than 10 cubic yards each, at least one particle size distribution shall be performed on each 10 cubic yards or fraction thereof. The laboratory test procedure shall conform to that presented in ASTM D422. If materials fail to meet the gradation requirements, the Contractor shall remove all delivered materials that are representative of the failing tests, and shall adjust his operations to produce acceptable materials.

1.4.2.4 Deficiencies

Corrective actions shall be taken when quality control or quality assurance detects nonconformance with specifications. The details of the irregularities and the actions taken to correct them shall be reported immediately to the representative of the Contracting Officer and included in the daily quality Control report. Corrective action shall include steps taken to prevent recurrence of the deficiency.

1.4.2.5 Reporting Well Completion

A completion report shall be completed for each well, and shall include a drillers log of the boring, an as-built drawing (showing elevations of the well screen and riser pipe, backfill material, and filter pack monitor pipes), and a development report. The elevations at which changes of materials are encountered shall be shown to the nearest 0.1 foot on this log. The log of filter pack material shall include the filter pack particle size distribution test data, and notes concerning installation and development of the well. The development report shall include the development method used, elapsed time for each development cycle, pumping test results, amount of material pulled into the well, filter pack elevation changes outside the riser, and total development time. Sample forms and logs to be used shall be requested from the Contracting Officer. Completed reports and logs shall be submitted the day after the work for which the report is made.

1.4.3 Contractor Supervision

The Contractor shall provide for the supervision of all phases of relief well drilling, installation, development, and testing. All drilling shall be performed by drillers having the experience described in subparagraph, "General". The Contractor shall submit, 2 weeks prior to drilling, the names of the supervisors and the driller(s), with resumes of their personal qualifications, years of experience, and drilling project references.

1.4.4 Obstructions

If obstructions are encountered in the foundation which, in the opinion of the Contracting Officer, render it impracticable to complete the well to the directed depth, the Contracting Officer may adjust the depth to conform to that of the obstruction. Alternatively, the Contracting Officer may direct the Contractor to abandon the borehole by backfilling with medium filter pack tremied to 20 feet below the ground surface and grouting the remaining borehole as specified in **paragraph, Grouting.**

1.4.5 Construction Limits

Construction activities including well drilling, material storage, vehicle parking, and staging areas shall be limited to the area defined in Section, LEVEE CONSTRUCTION AND EARTHWORK.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Riser Pipe

All pipe shall be new. Riser pipe shall be 8-inch diameter Schedule 40 Type 304 stainless steel pipe with a wall thickness of 0.322 inches. Pipe shall conform to ASTM A-312. A Certificate of Compliance from the manufacturer shall be submitted.

2.1.2 Well Screen

The Contractor shall furnish new commercially manufactured well screen of Type 304 stainless steel, having a nonclogging, wire-wrapped, continuous-slot vee-wire strainer, equivalent to that manufactured by Johnson Screens, Inc., Howard Smith Screen Co., or Cook Well Strainer Co. The well screen shall be 8-inch diameter; the width of the clear space between wire wrappings (slot size)shall be as shown in the drawings. A supplier's Certificate of Compliance shall be submitted. Connecting rings on screens shall be considered screen for measurement purposes.

2.1.2.1 Coupling

Couplings for connecting the well assembly in the field shall be threaded. Couplings shall be constructed of the same material as the well screen and shall conform in design to the couplings recommended by the manufacturer of the well screen. Couplings in the riser pipe shall be either threaded conforming to ASTM A403, or or shop-welded. All field-welding shall be made by a qualified welder.

2.1.2.2 Bottom Blank and Plug

The bottom blank for each well shall be 1 foot long and shall be made of zero-slot stainless steel screen. The bottom plug for each well shall be made of the same material and at least 3/8-inch thick. Plugs shall be the same diameter as the outside of the riser and shop-welded to the bottom blank. If field adjustments in bottom plugs, blanks, or screens are necessary, all field-welding shall be performed by a qualified welder.

2.1.3 Filter Pack

Filter pack shall be clean, washed, free draining, durable, rounded natural siliceous sand free from clay balls, and shall be within the gradation limits shown in the drawings. Calcareous and deleterious substances (which include soft friable or elongated particles, objectionable materials and other foreign matter) shall not exceed 5 percent by weight; the material shall be approved prior to use. The Contractor shall submit documentation in accordance with paragraph titled "Sampling and Testing". The coefficient of uniformity (defined as the D60 passing divided by the D10 passing) shall be $\leq$2.5 for all the primary filter packs and <4 for secondary filter pack.

2.1.4 Drilling Fluid Additives

Potable water shall be used as the drilling fluid. If additives are necessary, the drilling fluid additives for relief well drilling shall be limited to approved organic, self-destructing, biodegradable material equivalent to Johnson Revert, Wyo-Ben G-150, or American Colloid Vari-flo, and compatible additives. No bentonite shall be used in the drilling fluid.

2.1.5 Grout

Grout shall consist of a mixture of water, Portland cement and bentonite. Portland cement shall conform to ASTM Standard C150. Mix water shall conform to paragraph "Restrictions on Source of Water" of this section. Accelerators meeting the requirements of ASTM C494 Type C or E may be used

with prior approval. Grout shall have a weight of 13.5 pounds per gallon, and contain 2 percent bentonite by weight of cement.

2.1.6 Bentonite

Bentonite for surface casing sealing and grouting shall be a natural environmentally compatible sodium montmorillonite clay with a 200-mesh grind.

2.1.7 Filter Pack Monitor Pipes

Filter pack monitor pipes shall be new 3-inch diameter schedule 80 PVC pipe conforming to ASTM F-480.Text

PART 3 EXECUTION

3.1 DRILLING OF THE WELL

3.1.1 General

Relief wells shall be drilled by the reverse circulation rotary method, using equipment and procedures which will ensure verticality and proper placement and depth of well screen, riser pipe, and filter pack. No other method will be permitted, except for other approved methods for placement of the surface casing prior to drilling the well borehole. The 16-inch-diameter borehole shall be started at the location indicated in the plans and surveyed in the field, unless otherwise approved by the Contracting Officer. The borehole may be drilled deeper than the final design depth of the well to allow for cutting settlement, at the Contractor's discretion and expense. The borehole shall be cleaned of drill cuttings prior to installing the well assembly. The drill rig shall be set up such that the bit is centered in the temporary surface casing. A tolerance of 1/2-inch will be allowed. Using the drill bit and stem as a plumb bob will not be allowed as a means of assuring that the hole and the surface casing will be vertical. A 4-foot (minimum length) carpenter's level shall be used on the drill rods prior to drilling and during drilling to ensure verticality. A level is required with each drill rig.

3.1.2 Control of Drilling Fluid

Tests of the drilling fluid weight, in pounds per gallon, shall be performed at the beginning and near the end of drilling of each well and at least twice in between. Drilling fluid additives, and proposed methods for handling fluid loss in coarse gravels with these additives, shall be submitted for approval.

3.1.3 Temporary Surface Casing

The surface casing shall have a nominal outside diameter of not less than 24 inches. It shall have sufficient thickness to retain its shape and maintain a true section throughout its depth, and may be in sections of any convenient lengths. The surface casing shall be constructed to permit its removal without disturbing the filter pack, riser, well screen, or monitor pipes. Surface casing shall be set so that no cavity will be created

outside of it at any point along its length. Temporary surface casing shall be required in the hole to 0.5-feet into the primary filter pack. The drilling fluid shall be maintained at the top of the surface casing at all times during drilling, tool removal, well placement, and filter pack placement. The temporary casing shall remain in place throughout the first development process and until grout for the plug has been placed. In the event that the surface casing becomes distorted, the Contracting Officer will order its removal and the installation of new casing. The temporary surface casing shall be installed vertically, and the annulus sealed with bentonite and other materials as necessary.

3.1.4 Drilling Fluid Pits

Excavation for drilling fluid pits will not be permitted. Drilling fluid pits shall be portable. The pits shall have a minimum operational capacity equal to three times the volume of the borehole to be drilled and if necessary, shall incorporate desanders to separate fine material from the drilling fluid. The methods for assuring proper settling and separation of cuttings from the drilling fluid during drilling (along with detailed diagrams of equipment) shall be submitted for approval.

3.2 INSTALLATION OF RISER PIPE AND SCREEN

3.2.1 Assembly

All riser pipe and screen shall be in good condition before installation and all couplings and other accessory parts shall be securely fastened in place. If the well assembly is manufactured off-site, extreme care shall be taken during shipment to prevent bending of screen and riser pipe. Any dents, bends, cracks, or other damage to well screens and riser pipes shall be grounds for rejection by the Contracting Officer. Wood "splints" shall be used on screens as necessary to prevent bending or twisting during on-site handling. The successive lengths of pipe shall be arranged to provide accurate placement of the screen sections in the soil strata. Centering devices shall be attached to the assembled riser pipe and screen in such numbers, and shall be of a type that will satisfactorily center the riser pipe and screen in the borehole, and will hold it securely in position until the filter pack is in place. A minimum of three centering devices shall be used on each well, with one near the bottom of the assembly, and one near the top, below the surface casing depth. Centering devices shall be installed on blank riser pipe or on well screen connection collars. The Contractor shall take care to align centering devices so that they will not inhibit the placement of tremie pipes on any side of the well. Details of centering devices and their placement shall be submitted for the Contracting Officer's approval prior to their use.

3.2.2 Joints

Sections of relief well pipe and screen shall be joined as specified in subparagraph, "Coupling". Joints shall be designed and constructed to have the strength of the pipe and shall be capable of supporting the weight of the relief well assembly as it is lowered into the borehole. Joints shall be made so that the well is straight, with no more than 1-inch deflection at any point on the assembly when measured with a string line.

3.2.3 Installation

The riser pipe and well screen shall be lowered into the borehole to within a tolerance of ±0.1 foot of the design depth, in a manner that will avoid jarring impacts and ensure that the assembly is centered and not damaged or disconnected. "Bumping" the assembly by raising and dropping, will not be permitted. If insufficient borehole depth is available, the well assembly shall be removed and the borehole shall be cleaned. When the boring is completed, recirculation of the drilling fluid from the bottom of the borehole shall be maintained until all suspended cuttings are removed through the fluid pit and desander system, as determined from sampling fluid from the return side of the fluid pit. This is required prior to installation of the riser and screen assembly. Airlifting using approved equipment with airline and eductor piping to remove settled material is permitted, provided the fluid level in the borehole is maintained at the top of the surface casing. After the screen and riser have been placed, the assembly shall be clamped securely in place at least until after the first mechanical development to prevent settlement of the well. After clamping the well, primary filter pack shall be placed as specified in paragraph, "Placement of Filter Pack". The top of the riser pipe shall be secured at the specified elevation during placement of the primary filter pack. The well shall be developed as specified in paragraph, "Development of Well" prior to installation of the secondary filter pack.

3.2.4 Alignment

Relief wells shall be installed and maintained straight and plumb and at the design elevation within a tolerance of ± 0.1 foot. Alignment shall be tested before filter pack placement by using a 20-foot-long cylindrical dummy, or a dummy with a central shaft and discs, with an outside diameter 1 inch less than the minimum inside diameter of the screen. The dummy shall be lowered through the well casing and screen to the bottom of the well. If the well does not meet the alignment check, the well assembly shall be removed, corrected and returned to the borehole prior to filter pack placement.

3.2.5 Filter Pack Monitor Pipes

The monitor pipes shall be attached to the riser as shown in the drawings, with caps on both ends to prevent grout infiltration. The lower cap and encasing grout shall be drilled out after the grout has set, to allow access to the top of the filter pack.

3.2.6 Welding

Field welding of well materials shall be in accordance with AWS D1.1. Qualifications of welding procedures and welders shall be in accordance with AWS D1.1, Section 5. Copies of welding test procedures and records for each qualified welding operator containing records on position of welding and types of electrode qualifcations shall be provided to the Contracting Officer upon request.

3.3 PLACEMENT OF FILTER PACK

3.3.1 General

After the well screen and riser pipe have been installed, the primary filter pack material shall be placed by a tremie pipe having a minimum inside diameter of 3 inches and slots to assist in the prevention of bridging in the pipe. The filter pack shall have a nominal thickness of 4 inches between the outside of the well screen and the natural formation and shall be placed to the depths shown on the installation details. At the start of operations, the tremie pipe shall rest near the bottom of the hole and be filled with primary filter pack material. The tremie (and temporary casing if used) shall then be raised in increments not to exceed 2 feet, allowing the filter material to flow out the bottom. After the backfilling has started, a continuous supply of primary filter pack material shall be placed in the top of the tremie. A 150 ppm solution consisting of 0.02 pounds calcium hypochlorite to 10.5 gallons of water shall be used to wash the pack through the tremie pipe. Secondary filter pack shall be placed in the same manner after the completion of the first mechanical development. All filter pack shall be placed and maintained to within $\pm$ 0.25 feet of the depths specified on the installation detail. Secondary pack shall not be placed on top of any sediment. Sediment shall be removed and the primary filter shall be adjusted to within $\pm$ 0.25 feet of the specified depth.

3.3.2 Removal of Fines

Immediately after placement of the filter pack, the well and annulus shall first be bailed or airlifted to remove any fine material. If drilling fluid additives are used, breakdown agents shall be used as recommended by the drilling fluid manufacturer.

3.3.3 Initial Pumping

The purpose of this task is to remove as much drilling fluid as possible from the borehole prior to development. Within 24 hours after placement of filter pack, 150 gallons of water per linear foot of filter pack shall be pumped from the well and checked for appearance and viscosity as indicators of the presence of drill fluid. Drill fluid shall be re-used or disposed of in accordance with Section, HTRW CONTINGENCY PLAN.

3.4 DEVELOPMENT OF WELL

3.4.1 General

The Contractor shall develop the well to remove the filter cake from the walls of the borehole, to remove all fines which can be drawn through the well screen, and to stabilize the filter pack and foundation aquifer contact. Mechanical development shall consist of surging and pumping, jetting, or other approved methods. Airlifting will be allowed to remove material pulled into the well but will not be considered an alternative to pumping. Mechanical development shall be performed for up to 8 hours per well. Development shall be considered complete when no visible sediment is present in pint jar water samples which have been allowed to stand for ten (10) minutes. All materials pulled or introduced into the well during development, shall be removed prior to performing the

pumping test. After the mechanical development, the primary filter pack shall be brought up to within 0.25 feet of the specified elevation.

3.4.1.1 Addition of Filter Pack Material

As development proceeds, primary filter pack material shall be added to the annular space around the riser, to maintain the top of the filter pack within 0.5 feet of the specified elevation. If, at any time during the development process, the filter pack becomes contaminated with any silt or other foreign material, the material shall be removed and the pack restored to the specified tolerance. The Contractor shall provide an approved means for accurately measuring the water level, depth in the well, and depth to pack at all times and under all conditions. If, at any time during the development process, it becomes apparent, in the opinion of the Contracting Officer, that the well may be damaged, development operations shall immediately cease. The Contracting Officer may require a change in method if the desired results are not achieved. A well which continues to produce visible sediment in jar samples after 8 hours of development, may be ordered to be abandoned, plugged, and backfilled, and may require that the Contractor construct a new well nearby.

3.4.1.2 Surging

Surging shall be performed continuously for 1/2-hour increments, then interrupted to measure and remove material drawn into the well. Surging increments shall be interrupted if material blocks ten percent (10%) or more of the screen (lower screen on wells with more than one screen) during a surging increment; and the well shall be cleaned before development continues.

3.4.1.3 Intermittent Pumping

Intermittent pumping may be used to aid in development; however, it shall not be used as the primary means of development. Pumping may consist of up to 50 percent of the development time at the discretion of the Contracting Officer. All discharge from intermittent pumping, as well as any other pumping under this contract, shall be discharged over the levee in a manner to prevent erosion. Any such damage shall be immediately repaired.

3.4.2 Surging Method

Surging of the well shall require the use of a circular block which has a solid wooden core approximately 2 inches smaller in diameter than the inside diameter of the well, and rubber or leather discs which are nearly the same diameter as the inside diameter of the well. The surge block assembly shall weigh a minimum of 300 pounds and weights shall be added as necessary to increase the effectiveness of the downward strokes of the surge block. The Contractor shall submit a drawing, with dimensions and weights, of his surge block for approval by the Contracting Officer. A bailer, sand pump or airlift device shall be used to completely remove all materials drawn into the well between surge cycles. The surge block shall be operated with a smooth motion. Surge strokes shall be a length of 3 to 4 feet, operating at a rate of approximately 1 foot per second. Surging shall be initiated with the surge block in the casing just above each

screen, and shall progress downward in 3- to 5-foot increments through the screened areas. Each well shall be surged in this manner. No violent surging (as with compressed air) will be permitted.

3.4.3 Jetting Method

Jetting may be used as a method of development. The jetting must be performed with an approved jetting tool with a minimum jetting velocity of 150 feet per second, with centering devices and a pump below the jetting tool. Jetting water shall conform to paragraph, "Restrictions on Source of Water" of this section. Pumping must be performed simultaneously with jetting operations and at a higher rate than the jetting tool flow rate.

3.5 WELL COMPLETION

3.5.1 General

Well completion consists of the following items: placement of secondary filter pack, grouting, forming or placing concrete boxes or manholes with reinforcing steel, and other items as shown on the general contract plans.

3.5.2 Secondary Filter Pack

After completion of the mechanical development, the secondary filter pack shall be tremied in place as specified in paragraph, "Placement of Filter Pack", to the depth shown on the installation detail.

3.5.3 Grouting

The grout shall be placed through a tremie pipe. The bottom end of the tremie pipe shall have a plug or tee fitting, and the lower portion of the tremie pipe shall have horizontal discharge ports to prevent jetting into the secondary filter pack. The tremie pipe shall be lowered to 0.5 foot above the top of the secondary filter pack prior to starting grout placement, and the discharge end of the pipe shall be submerged in the emplaced grout at all times until grouting is competed. The well riser shall be plugged and shall be watertight before and during grouting. If an accelerator is to be used, the type and quantity to be used shall be submitted for and is subject to approval of the Contracting Officer.

3.5.4 Surface Features

Manholes, reinforcing steel, concrete, riser covers, outflow pipes, flap valves and check valves shall be installed as shown on the drawings and as indicated within the specifications.

3.6 PUMPING TESTS

Upon completion, but before acceptance, the well shall be pump-tested for well efficiency. While pump tests are being conducted, no other pump testing shall be occurring, no drilling, excavation, compaction grouting, development or other pumping will be allowed. The Contractor shall furnish a pump capable of pumping at constant rates as shown in the drawings. The pump shall be complete with an adequate power supply. If the Contractor

elects to use an electric-powered pump, he shall furnish, without additional cost to the Government, the electric power and necessary wiring. The Contractor shall provide an electric tape, bubbler tube, or other approved means for accurately determining the water level in the well under all conditions. The contractor shall furnish and install an orifice meter, or turbine flow meter of approved design for the purpose of accurately measuring the discharge rate from the well at all times during the pump tests. The Contractor shall furnish, install, or construct the necessary pipe and discharge lines to dispose of the pumping test discharge over the levee without causing damage or erosion. An approved centrifugal sand sampler shall be installed in the discharge pipe to determine sand content of the discharge. Test data shall be recorded by the Contractor. The Contractor shall ensure the accuracy of the pump test data. Prior to starting the pump test, the water level shall be allowed to reach static level. The well will be considered to be at "static" when the water level fluctuates less than 0.1 foot in 30 minutes. After the drawdown has stabilized at the initial pumping rate, the Contracting Officer will direct an increased pumping rate, and the test shall be repeated. A minimum of four such steps shall be run. Pumping rates in excess of 500 gpm will not be required. It is anticipated that pumping tests will range between 2 1/2 to 6 hours, and not exceed 6 hours. If the test is interrupted prior to completion, other than by direction of the Contracting Officer, the test shall be rerun at no additional cost to the Government. If the pump tests indicate incomplete well development by either drawing excessive fines into the well during the tests or by exhibiting an increasing specific capacity with increase in pump rates, the Contracting Officer may direct removal of sand or sediment from the well, additional development, and additional pump testing. Excessive sediment shall be considered to be amounts in excess of 5 parts per million during the last 15 minutes of the pump test.

3.7 STERILIZATION

The Contractor shall disinfect the wells upon completion. Manufacturer's data for the sterilization chemicals shall be submitted for approval. Disinfection shall consist of placing a 500 ppm sodium hypochlorite solution throughout the screened portion of the well column at a rate of 50 gallons of solution per foot of well screen, and placing a 3-inch chlorine tablet near the bottom of the well. The solution shall stand in each well for a minimum of 6 hours. The inside of the riser pipe above static water level shall be swabbed with the chlorine solution.

3.8 RESTORATION OF WORK AREA

3.8.1 Drill Cuttings

Cuttings shall be placed in off-site disposal areas.

3.8.2 Earthwork

Earthwork will be addressed within Section, LEVEE CONSTRUCTION AND EARTHWORK.

3.8.3 Trash

Trash and housekeeping wastes shall be disposed of at an off-site landfill.

3.9 RESTRICTIONS DUE TO RIVER ELEVATION

No well drilling shall be started if the river is approaching or is above flood stage or river freeboard gauge. The Contractor shall fill any partially completed boreholes with filter pack, and cap the top 10 feet with a mix of sand and bentonite. No open borehole or well without complete primary filter pack installation shall be left unattended. Wells without completed filter pack, grout seal, and locking protective cover or manhole with flap gates or check valves, shall not be left unattended for more than 12 hours. If flood stages are forecasted before wells are completed, then all riser pipes and related openings shall have temporary covers prepared to install when necessary to prevent inundation from flood waters.

3.10 RESTRICTIONS ON SOURCE OF WATER

Only public potable sources of water shall be used for drilling fluids, filter pack wash water, grout mixes, and development jetting. Vessels used to haul water shall be dedicated to this purpose to prevent possible contamination.

-- End of Section --

SECTION 02220

DEMOLITION
12/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Work Plan; GA-RE.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

Salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.6 Environmental Protection

The work shall comply with the requirements of Section, ENVIRONMENTAL PROTECTION FOR CIVIL WORKS.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.8 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed completely, including foundation walls and basement slabs. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage

and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for the Government

No items are identified for the Government.

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. Any items reserved as property of the Government shall be delivered to the areas designated by the Contracting Officer.

3.4.1.3 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off the site. Combustible material shall be disposed of off the site.

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and depths indicated on the drawings.

-- End of Section --

SECTION 02228

ROCKFILL
04/01

PART 1 GENERAL

This Section covers rockfill and field acceptance tests, complete.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

STANDARDS DEVELOPMENT ORGANIZATION (ACRONYM)

ACRONYM REF-ID (issue/revision date) Publication Title

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Plan of Operations; GA-RE.

SD-08 Statements

Aggregate Sources; FIO-RE

Written verification that stone for use in Rockfill will be produced from the sources listed in the SPECIAL PROVISIONS; identify specific source of all stone material.

Test Methods; GA-EC

Written, detailed descriptions of the method of conducting specified Truckload Gradation and In-place Gradation tests.

SD-09 Reports

Field Test Reports; GA-EC

Written results of all Truckload Gradation and in-place Gradation tests,

including supporting computations.

Survey Data; FIO-RE

Field notes of surveys conducted prior to and following rockfill placement.

Weigh Bills: FIO-RE

Submit weigh bills for each truckload of Rockfill as it is delivered to the project site.

1.3 QUALITY CONTROL

1.3.1 Tests

Tests shall be performed for rockfill as specified below, and as directed, by the Contracting Officer, to determine if the rockfill material delivered to the job meets the gradation, elongation, and deleterious requirements specified herein. Tests for elongation shall be run on the plus 6-inch material only. The tests shall be coordinated to minimize interference with the construction progress. If the materials fail to meet the gradation, elongation, and deleterious materials limits specified, the Contractor shall adjust his operations as required to produce acceptable materials, or he shall propose another source of materials. Prior to placement of any materials, the Contractor shall submit for approval, in writing, the detailed methods of testing. The Contractor shall state in writing the method used in processing, loading and handling of materials for each test, and shall notify the Contracting Officer any time any production methods are changed. The field acceptance tests shall be performed on random loads selected by the Contracting Officer. Materials from load testing may be placed in the work if the materials meet specifications requirements.

1.3.1.1 Tests Required:

Type of Test	Min. Size of Test	Min. No. of Tests Required
Truckload Test	10 tons	one (1)
In-place Gradation	15' x 15'	one (1)

1.3.2 Surveys

The Contractor shall survey the area upon which rockfill is to be placed. The survey shall be completed before placing any rockfill. The Contractor shall again survey the completed rockfill layer. Cross-sections shall be taken as often as needed or as directed by the Contracting Officer, but not less than every fifty (50) feet. Points on the cross-section shall be taken at break points or as directed by the Contracting Officer, but not less than every twenty (20) feet. The indicated lines and grades on the drawings will be the basis for computation of quantities. Rockfill required to correct deviations from plan grade in excess of specified tolerances will be excluded from payment quantities.

PART 2 PRODUCTS

2.1 STONE

Stone for rockfill shall be sound, durable limestone, free from cracks, seams, partings, and overburden spoil. Stone shall be approximately rectangular in cross section, free from thin slabby pieces having an elongation ratio more than four, and the quantity of stone having an elongation ratio more than three shall not exceed 20 percent of weight. Deleterious substances which include soft friable particles, objectionable material, and other foreign matter, shall not exceed 10 percent by weight.

2.1.1 Gradation

The stone shall be graded from coarse to fine. The material shall have a maximum size of 700 pounds, with not more than 50 percent of the material smaller than 100 pounds. The material may contain up to a maximum of 25 percent fines (by weight) except that the outer 3 feet of the rock shell section shall not contain more than 15 percent fines (by weight). Fines are defined as material smaller than 3 inches in size.

2.1.2 Sources and Approval of Materials

Stone protection shall be produced from the sources listed in the Section, GENERAL.

PART 3 EXECUTION

3.1 PLACEMENT

Except for rockfill materials placed against structures, and rockfill placed below the existing water surface, which may be placed in one lift, rockfill shall otherwise be placed in lifts not exceeding 3 feet in thickness. Care shall be taken in placing stone against pipes and other structures; stone placed within a distance of 1 foot from the exterior of pipes or structures shall be placed by hand; stone placed in the remainder of the area may be placed in one lift. At no time will the toe of the rockfill being placed be more than 50 feet from the toe of the excavation. The temporary earthcut (finished subgrade template) shall not be excavated more than 50 feet ahead of the placement of rockfill; the required general sequence for construction of the rockfill is specified in Section, LEVEE CONSTRUCTION AND EARTHWORK. Transitions from the temporary earthcut section to the existing ground surface shall not exceed 100 feet in length. Bridging shall be broken down so that the resulting fill forms a fully stable mass. Any crust or concentrations of fines at the surface of the lift which, in the opinion of the Contracting Officer, will interfere with bonding, shall be broken up prior to adding the next lift. Dumping and spreading shall be controlled to obtain rock to rock contact without objectionable pockets of fines or concentrations of large pieces. Generally, the larger pieces of stone shall be placed near the riverside slope. A tolerance of plus 0.2-foot from the indicated lines and grades for rockfill will be permitted.

3.2 SCALES AND WEIGHHOUSE

Scales shall be standard truck scales of the beam type and of sufficient

size and capacity to accommodate all trucks used in hauling material. Scales shall be tested, approved, and sealed by an inspector of the State Inspection Bureau charged with scales inspection within the State of Missouri, or by the Contracting Officer if the services of an official inspection bureau of the State are not available. Scales shall be recalibrated and resealed as often as necessary to ensure continuous accuracy. The number of standard weights necessary for testing the scales shall be on hand at all times.

3.3 MAINTENANCE

The contractor shall maintain the rock fill until the project is completed and any material displaced by any cause, except as provided in paragraph: "DAMAGE TO WORK" of the SPECIAL CLAUSES, shall be repaired to the lines and grades shown on the drawings as directed.

-- End of Section --

SECTION 02251

CHEMICAL GROUTING GATEWELL 9 EXCAVATION

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

Driven sheet piling will not be present at the sides of and below the 72-inch sewer line. Groutable soils, anticipated to be present at these unbraced locations, shall be grouted before vertical cuts are made below the top of the 72-inch line to allow construction of the spread footing for Gatewell 9. This section of the specifications covers injection of chemical grout for the purpose of increasing the strength and stability of groutable soils in the grout zones shown on project documents to prevent ground loss and associated settlement of the 72-inch line adjacent to the excavation.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA-RE" designation; submittals not having a "GA-RE" designation are for information only. When used, a designation following the "GA-RE" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Grouting Equipment; GA-RE.

Materials; GA-RE.

A description of the materials to be used and the proposed methods of Operations; GA-RE.

Details and data on the grouting equipment shall be submitted for conformance with the requirements of paragraph EQUIPMENT.

Grout Mix Test Results; GA-RE.

Certified laboratory test results documenting the required performance of the proposed chemical grout mix shall be submitted at least 30 days prior to the commencement of injection operations.

SD-08 Statements

Chemical Grouting Work Plan; GA-RE.

A detailed Work Plan that shows the equipment and grout plant layout and explains key operations including mixing methods and grout injection procedures shall be submitted at least 30 days in advance of start of grouting operations. The Work Plan shall also detail the order of operations and show the basis for establishing grout target volumes.

Qualifications; GA-RE.

A statement of qualifications of the grouting subcontractor shall be submitted at least 30 days in advance of start of grouting operations. At a minimum, the grouting subcontractor and the grouting subcontractor's superintendent shall have satisfactorily completed at least 5 chemical grouting projects of relatively similar scope and purpose using the continuous mixing procedure, automatic recording equipment, and types of chemical grout specified herein.

1.3 MATERIALS DELIVERY, STORAGE AND HANDLING

Chemical grout materials shall be transported, stored and handled as recommended by the manufacturer and in accordance with all applicable regulations.

1.4 PROJECT/SITE CONDITIONS

The program shown and described is based on currently available information. As new information becomes available during construction, grouting mixes, pressures, injection rate and injection location sequence may be modified in the field with the approval of the Contracting Officer. If conditions encountered during construction differ significantly from those anticipated, the Work Plan may need to be revised and resubmitted before work continues. Preventing ground loss from below the adjacent 72-inch sanitary sewer is a required part of the design and shall not become secondary to any time or scheduling constraints.

PART 2 PRODUCTS

2.1 CHEMICAL GROUT MATERIAL

Chemical grout will be composed of liquid sodium silicate, approved reactant, water and accelerator, if required. The design chemical grout mix shall be such that, when injected into medium dense Ottawa 20-30 sand, the unconfined compressive strength of the grouted soil shall average at least 75 psi.

2.1.1 Sodium Silicate

The base material for the structural chemical grout shall be liquid sodium silicate, which shall have a specific gravity of 1.4 to 1.5 (41.5º to 48.3º Baume) and a silicate to soda ratio in the range of 3.20 to 3.35. The minimum sodium silicate concentration shall be 50 percent of the mix by volume. The sodium silicate should be delivered in sealed containers or certified tank truck and shall be accompanied by the supplier's certificate of origin. Sodium silicate in ungelled liquid form, while not considered toxic, is strongly alkaline and shall be handled by authorized personnel

only.

2.1.2 Reactant

The reactant shall be of organic base type and shall, when properly mixed with the other grout components, provide a permanent, irreversible gel with controllable gel times. The resulting gels shall exhibit less than 2 percent syneresis in injected sample in 30 days when mixed with appropriate amounts of sodium silicate, water and accelerator, and shall not exhibit objectionable odors such as ammonia.

2.1.3 Accelerator

The accelerator, if required, shall be technical grade, water-soluble calcium chloride or other approved metal salt and shall contain a minimum amount of insoluble.

2.1.4 Water

Water used with grout shall be free of impurities that will affect the grout.

PART 3 EXECUTION

3.1 EQUIPMENT

3.1.1 General

All chemical grouting equipment shall be of a type, capacity and mechanical capability suitable for doing the work. The equipment shall be maintained in first class operating condition.

3.1.2 Pumps

The chemical grout plant shall be of the continuous mixing type and shall be capable of supplying, proportioning, mixing and pumping the grout with a set time between 5 minutes and 50 minutes. Batch-type systems will not be permitted. Each main pump shall be equipped with recording, positive displacement meters. The meters shall be constructed of materials that are non-corrodible for the intended products and shall operate independently of the viscosity of the metered fluid. The pumping unit shall be capable of varying the rate of pumping while maintaining the component rates constant. Pumps shall be capable of delivering grout to the point of injection at a pressure of not less than 2 psi for every foot of overburden.

3.1.3 Piping and Accessories

The pumping unit shall be equipped with piping and/or hoses of adequate capacity to carry the base grout and reactant solutions separately to the point of mixing. The hoses shall come together in a wye fitting containing check valves to prevent backflow. The wye fitting shall be followed by a suitable baffling chamber. A sampling valve shall be placed beyond the point of mixing and the baffling chamber and be easily accessible for sampling mixed grout. A water flushing connection or valve shall be placed

behind the wye to facilitate flushing the grout from the mixing hose and baffle between grouting sessions. Distribution of proportioned grout, under pressure, to the grouting locations shall be monitored by separate, automatic recording, flow rate indicators and gages. Flow rate indicators shall be accurate within 10 percent at a flow rate of 2.5 gpm.

3.1.4 Chemical Tanks

Chemicals shall be stored in metal tanks, suitably protected from accidental discharge by valving and other necessary means. Tank capacity shall be sufficient to supply at least one day's worth of grouting materials so as not to interrupt the work in the event of chemical delivery delays.

3.1.5 Testing Equipment

The contractor shall provide at the site all necessary chemical quality control testing apparatus, including but not limited to: hydrometers, pH paper, graduates, and all other devices that are required to conduct chemical material acceptance tests, chemical proportioning tests, and grout quality tests for proper quality control of the work.

3.2 PROCEDURES

3.2.1 General

Grouting is expected to be accomplished using lances or other short injection pipe methods from within the excavation. Surface injection methods may be acceptable but are not considered to be practical due to the steep slope at the site and the difficult geometry associated with grouting the underside of the sewer line from the surface. Grouting shall not be performed until all sheet piles are driven. Soils in the grout zones defined by project documents shall be grouted such that the depth of grouted soils exceeds the depth of excavation by at least 1 foot at all times. Before excavation adjacent to grout zones continues, the grout zone shall have been thoroughly impregnated and stabilized with chemical grout to the required depth to the satisfaction of the Contracting Officer.

3.2.2 Work Plan

Work shall be performed according to the approved Work Plan.

3.2.3 Grouting Mixing Method

The method of injection for chemical grouting shall be the continuous mixing method, with the proper amounts of sodium silicate base material, water, reactants, and accelerator automatically proportioned and continuously supplied at proper flow rates and pressures. The batch system of mixing grout shall not be permitted. The base material and the water-accelerator-catalyst solution shall pass through parallel separate hoses to a suitable baffling chamber near the top of the hole. A sampling check, to allow frequent gel time checks, shall be placed after the baffling chamber. Suitable check-valves shall be placed in the grout lines at the proper locations to prevent backflow.

3.2.4 Injection Procedures

If sleeve pipes are used, chemical grouts shall be injected into the design zones through grout ports in the sleeve pipes using double packers. Temporary very high injection pressures will be permitted to crack open sleeve ports, but these pressures will not be permitted for longer than a one-minute duration. In any event, the rate of injection into any port shall not exceed three gallons per minute.

3.2.5 Gel Times

All grouts shall have a gel time between 10 and 50 minutes, with most grout having gel times in the range of 20 to 40 minutes. Samples shall be obtained for gel time checks at least once every 1/2 hour of pumping or for every 500 gallons of grout, whichever is more frequent. Gel samples shall be properly labeled and stored until the completion of the project.

3.2.6 Record Keeping

Accurate and timely records of all chemical grouting shall be kept by the grouting subcontractor and submitted to the Contracting Officer. These records shall include, but not be limited to, grout mix, gel time, injection date and time, injection pressure and rate, injection volumes, and exact injection location. In addition, these data shall be displayed in an acceptable chart-type format that facilitates rapid visual evaluation of the results of the work. This display shall be updated daily.

3.2.7 Correcting Exposed Insufficiently Grouted Soils

As excavation exposes grouted soils, and soils are observed to have not been sufficiently grouted, excavation shall cease until such soils are sufficiently grouted or braced as approved by the Contracting Officer. This work will be paid for at the same unit rate as Injected Chemical Grout.

3.2.8 Protection of Existing Improvements

During grouting operations, the Contractor shall take such precautions as may be necessary to prevent drill cuttings (if any), equipment exhaust, equipment oil, wash water and grout from defacing or damaging permanent improvements including the 72-inch line and nearby roadways and bridges.

-- End of Section --

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS
11/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 698	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-09 Reports
Field Density Tests; FIO-RE.
Testing of Backfill Materials; GA-RE.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SM, SW-SM, SC, SW-SC, CL, and CH.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.5 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.6 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed

gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the l inch sieve. The maximum allowable aggregate size shall be 1 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.7 Flowable Fill

Flowable fill shall be free of potentially expansive or corrosive materials, including chloride ions or calcium chloride. Use flowable fill mix as required in SECTION 02318 CONTROLLED LOW STRENGTH BACKFILL (FLOWABLE FILL).

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

3.2 EXCAVATION

Excavation shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the

excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.2.1 Trench Excavation Requirements

The trench shall be excavated in accordance with section LEVEE CONSTRUCTION AND EARTHWORK, or as shown. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.2.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed to a minimum of 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with impervious material or with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.2.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock

and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.2 Stockpiles

Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government.

3.3 BACKFILLING AND COMPACTION

Backfill material shall generally consist of impervious material. Select granular material shall only be allowed outside the critical area (500 feet landward or 300 feet riverside of the centerline of the levee), except for the work riversides of R2 rolling gate. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to 70 percent relative density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.3.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.3.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with impervious material or with select granular material if outside of the critical area.

3.3.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with impervious material or with select granular material, if

outside the critical area or is being used as shown at the R2 rolling gate location, and placed in layers not exceeding 6 inches loose thickness.

3.3.1.3 Backfill Around Pipes

Backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.3.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways and railroads, shall be filled with satisfactory material, as specified in paragraph BACKFILLING AND COMPACTION. Backfill material shall be placed and compacted as follows:

a. Roadways and Railroads: Backfill shall be placed up to the subgrade elevation in accordance with the requirements in Section: LEVEE CONSTRUCTION AND EARTHWORK. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 70 percent relative density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.3.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.4 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities to be relocated by the Contractor are as follows:

3.4.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 18 inches of cover in rock excavation and not less than 24 inches of cover in other excavation, unless otherwise shown.

3.4.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 4 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe, unless otherwise shown. For fire protection yard mains or piping, an additional 6 inches of cover is required.

3.4.3 Heat Distribution System

Backfill material shall be free of stones larger than 1/4 inch in any dimension.

3.4.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise shown.

3.4.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 3 feet below finished grade unless otherwise shown.

3.5 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.5.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.5.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 698. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for backfill.

3.5.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 200 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when

using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. At least one field density test performed in accordance with ASTM D 1556 shall be made daily and used as a check of the results obtained with ASTM D 2922 or ASTM D 3017. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.5.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

SECTION 02318

CONTROLLED LOW STRENGTH BACKFILL (FLOWABLE FILL)
05/01

PART 1 GENERAL

1.1 General

CONTROLLED LOW STRENGTH BACKFILL (FLOWABLE FILL), BACKFILL CONCRETE, FLOWABLE FILL, and CONTROLLED LOW STRENGTH MATERIAL (CLSM) as specified or indicated is concrete used for structural backfilling applications. The concrete used for structural backfilling applications shall be referred to herein as Controlled Low Strength Material (CLSM). CLSM is a pumpable or flowable Portland cement concrete used for backfilling around structures, pipes, drains, and other important closures. CLSM shall conform to the requirements for concrete specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, and as modified herein. CLSM may only be used where specified or indicated.

Nonshrink grout shall be used for filling small voids where use of CLSM is determined to be impractical. Nonshrink grout may only be used where specifically approved in writing.

Non-Structural Flowable Backfill (if used) may be permitted for use in non-structural applications for filling voids below the frost penetration depth and which will not be exposed to flowing water during service conditions. Non-structural flowable backfill shall not be used for termination of pipe penetrations and other penetration closures. Non-structural flowable backfill shall not be used in or under structures or embankments. Non-structural flowable backfill shall conform to the MISSOURI STANDARD SPECIFICATIONS for HIGHWAY CONSTRUCTION, SECTION 621 FLOWABLE BACKFILL. Non-structural flowable backfill may only be used where specifically approved in writing.

1.2 REFERENCES

The publications listed below and in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

ACI 229	(1994) Controlled Low Strength Materials (CLSM)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 260	(1986) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 494	(1992) Standard Specification for Chemical Admixtures for Concrete
ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

MISSOURI STANDARD SPECIFICATIONS for HIGHWAY CONSTRUCTION, ENGLISH VERSION

SECTION 621	SECTION 621 FLOWABLE BACKFILL MISSOURI STANDARD SPECIFICATIONS for HIGHWAY CONSTRUCTION, ENGLISH VERSION, 1996 Edition. referred to herein as State Specifications.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Installation Methods and Procedures; FIO-RE

The Contractor shall submit the proposed Methods, equipment and procedures for use in placing, curing, and protection of CLSM, nonshrink grout, or non-structural flowable backfill.

Grouting Specialist Qualifications; FIO-RE

The contractor shall submit evidence that the grouting specialist used for placements of CLSM, nonshrink grout, or non-structural flowable backfill has had experience within the last 3 years on similar projects.

Mixture Proportioning, GA-RE

CLSM, Nonshrink grout, and non-structural flowable backfill mixture proportions shall be determined by the Contractor and submitted for review. The mixture quantities of all ingredients per cubic yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete, grout, and flowable backfill shall be stated. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce mixtures of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

Curing and Protection; GA-RE

The curing medium and methods to be used shall be submitted for review and approval.

Cold-Weather Placing; FIO-RE

If CLSM, nonshrink grout, or non-structural flowable backfill is to be placed under cold-weather conditions, the proposed materials, methods, and protection shall be submitted for review.

Hot-Weather Placing; FIO-RE

If CLSM, nonshrink grout, or non-structural flowable backfill is to be placed under hot-weather conditions, the proposed materials and methods shall be submitted for review.

SD-09 Reports

Quality and Gradation of Aggregates; GA-RE

Aggregate quality and gradation tests shall be submitted at least 30 days prior to start of CLSM, nonshrink grout, or non-structural flowable backfill placement.

Tests and Inspections; GA-RE

Test results and inspection reports shall be submitted daily and weekly as required.

SD-13 Certificates

Cementitious Materials; GA-RE

Cementitious Materials, including Portland Cement, nonshrink grout cement, Pozzolan, and Ground Granulated Blast-Furnace (GGBF) Slag will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and mill test reports shall be from samples taken from the particular lot furnished. No cementitious materials shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

Air-Entraining Admixture; GA-RE

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

Other Chemical Admixtures; GA-RE

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

Nonshrink Grout; GA-RE

Descriptive literature of the Nonshrink Grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered.

Aggregates; GA-RE

Aggregates used in CLSM and nonshrink grout shall be tested and evaluated in accordance with the requirements for aggregates specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Non-structural flowable backfill; GA-RE

Descriptive literature of the Non-structural flowable backfill proposed for use shall be furnished together with a certificate from the producer stating that it conforms the specified requirements, and is suitable for the application or exposure for which it is being considered. In addition a complete and detailed copy of the state specifications covering flowable backfill shall be furnished.

1.4 DESIGN REQUIREMENTS

1.4.1 CLSM Concrete Strength

Specified compressive strength f'c shall be as follows:
(3,500 psi) @ 28 days.....CLSM
Per ASTM C 1107.....Nonshrink grout

1.4.2 Maximum Water-Cement (W/C) Ratio

Maximum W/C shall be 0.45, by mass.

CLSM shall contain Portland cement in combination with GGBF Slag and Fly Ash. The water-cement ratio shall be determined in accordance with the requirements for concrete proportioning specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

The W/C ratio may cause higher strengths than that required by paragraph CONCRETE STRENGTH.

1.4.3 Flowable Backfill

Non-structural Flowable backfill design requirements shall conform to State Specifications.

1.5 TOLERANCES

Surface tolerances for CLSM, nonshrink grout, and non-structural flowable backfill placements shall conform to the requirements for concrete specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

PART 2 PRODUCTS

2.1 MATERIALS

All materials used in the work shall conform to the requirements of SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, except as otherwise specified or approved.

2.1.1 CLSM

Materials used in producing Controlled Low Strength Materials (CLSM), shall conform to the materials requirements for concrete specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. High range reducing admixture and other admixtures proposed for use shall conform to ASTM C 494. Admixture used in producing flowable concrete shall conform to ASTM C 1017. CLSM shall be air entrained, air entraining admixture shall conform to ASTM C 260. CLSM required for filling drain and pipe penetrations where specified shall be formulated to provide a nonshrink concrete. The cement used to produce nonshrink CLSM shall conform to the requirements of ASTM C 1107. (The cement manufacturer's requirements on proportioning, mixing, and placing shall be submitted with the mix design for approval) (The mix design submittal shall include the nonshrink grout cement manufacturer's certification that the cement is suitable for use in

this application.)

2.1.2 Nonshrink Grout

Nonshrink grout shall conform to the requirements of ASTM C 1107. Fine aggregate, if used, in nonshrink grout shall conform to the requirements for fine aggregates in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, except that fine aggregates shall be produced from crushed Burlington limestone.

2.1.3 Flowable backfill

Materials used in producing Non-structural Flowable backfill shall conform to the MISSOURI STANDARD SPECIFICATIONS for HIGHWAY CONSTRUCTION, SECTION 621 FLOWABLE BACKFILL.

2.1.4 Aggregates

Aggregates in the project area have shown to pose a durability concern for concrete mixtures, specifically alkali-silica reactions, Durability "D" cracking, and pop-outs. Aggregates shall be tested and evaluated in accordance with SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

2.2 MIX DESIGN and PROPORTIONING

CLSM - CLSM mix design and proportioning shall conform to the requirements for concrete mix design specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Nonshrink Grout - Nonshrink grout mix design and proportioning shall conform to the grout manufacturer's recommendations.

Non-Structural Flowable Backfill - Non-structural flowable backfill mix design and proportioning shall conform to State Specifications.

2.2.1 Air Content (CLSM)

Air content as delivered to the forms and as determined by ASTM C 231 shall be between 4-1/2 and 7-1/2 percent.

2.2.2 Slump (CLSM)

The slump for CLSM shall be determined in accordance with ASTM C 143 and shall not exceed 8 inches.

PART 3 EXECUTION

3.1 INSTALLATION

CLSM and Nonshrink Grout - CLSM shall be used as backfill material for rolling gates Q1, Q3, R2, and other structural backfilling as specified or indicated on the drawings, or as directed.

Where CLSM concrete mixtures containing coarse aggregate are determined to be impractical for backfilling operations in small pipes and voids, the voids may be filled using nonshrink grout, where specifically approved in writing.

Non-Structural Flowable Backfill - Non-structural flowable backfill conforming to State Specifications may be used in filling other voids as specified, where specifically approved in writing.

3.2 EQUIPMENT AND METHODS

CLSM and Nonshrink Grout - Equipment and methods proposed for use in producing, placing, curing and protection of CLSM and nonshrink grout shall conform to the requirements for concrete and nonshrink grout as specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Non-structural Flowable Backfill - Equipment and methods proposed for use in producing, placing, curing and protection of non-structural flowable backfill shall conform to State Specifications, except that equipment used in batching, mixing, transportation, and placing shall meet or exceed ASTM C 94.

3.3 PREPARATION FOR PLACING

CLSM and Nonshrink Grout - Surfaces to receive or otherwise to be in contact with CLSM and nonshrink grout shall conform to the requirements for concrete and nonshrink grout as specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Non-structural Flowable Backfill - Surfaces to receive or otherwise to be in contact with non-structural flowable backfill shall conform to State Specifications.

3.4 TESTS AND INSPECTIONS

CLSM and Nonshrink Grout - Tests and inspections of CLSM and nonshrink grout shall conform to the requirements for concrete and nonshrink grout as specified in SECTION: 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

Non-structural Flowable Backfill - Tests and inspections of non-structural flowable backfill shall conform to State Specifications.

END OF SECTION

02331

LEVEE CONSTRUCTION AND EARTHWORK
03/02

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all submittals, labor, equipment, plant, materials, and all efforts necessary to perform levee construction and general earthwork as defined for this project. In regard to earthwork whether it is excavation; handling; placement; work beneath, adjacent, or above a pipe; work beneath, adjacent, or above a structure; or earthwork in general, this section shall govern if there is disagreement with or between specification sections or plan sheets.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced or where the procedure or information is necessary for performance of the work. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 43	(1988; R 1995) Sizes of Aggregate for Road and Bridge Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1999) Concrete Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 698	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4253	(1993; R 1996) Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4254	(1991; R 1996) Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4643	(1993) Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
ASTM D 5195	(1991; R 1996) Density of Soil and Rock In-Place Below the Surface by Nuclear Methods

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section,01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Shoring, Sheeting, and Bracing; GA.

Submit a detailed shoring, sheeting and bracing plan 45 days prior to the beginning of any excavation so supported. The plan for shoring, sheeting and bracing shall be prepared and certified by licensed professional engineer. The plan shall include drawings and design computations of the proposed shoring, sheeting, and bracing, and documentation, showing details of the coordination and approval of shoring, sheeting, and bracing by the applicable parties. Approval of the detailed plan shall be obtained from the Contracting Officer's Representative (COR) prior to starting the work. If necessary, the plan shall be modified as required to meet field conditions, and the modifications shall be approved prior to use.

Excavation; GA.

Submit a written excavation plan 45 days prior to the beginning of any excavation. Approval of the detailed plan shall be obtained from the Contracting Officer prior to starting the work. If necessary, the plan shall be modified as required to meet field conditions, and the modifications shall be approved prior to use. As a minimum, the plan shall contain, the following:

a. Proposed methods for preventing interference with, or damage to, existing underground or overhead utility lines, trees designated to remain and other man-made facilities or natural features designated to remain within or adjacent to the construction rights-of-way.

b. Provision for coordinating the work with other Contractors working in the construction rights-of-way or on facilities crossing or adjacent to this work.

c. The proposed methods for controlling surface and ground water in the borrow areas and required excavations.

d. Stockpiling plan for embankment material before it is transported to the project site showing locations, stockpile heights, slopes, limits, and drainage around the stockpile areas.

e. A complete listing of equipment used for excavation and to transport the excavated material.

f. The Contractor's proposed sequence of work for excavating the borrow areas with plan and cross sectional views showing starting and final work locations and clearing, grubbing and stripping limits.

g. The Contractor's proposed road pattern, and plan for implementing dust control measures.

Borrow Areas; GA.

Submit a written statement to the COR not later than 5 days after receipt of Notice to Proceed indicating the Contractor's intention of fill sources to be used within this project and shall address required excavations as well as all other sources of fill identified.

Plan of Operations; GA.

Fifteen (15) days prior to commencement of haul road construction or placing embankment and backfill which ever is earlier, the contractor shall submit for approval a Plan of Operations for accomplishing all operations and for the location and construction of haul roads, as described herein. Approval of the detailed plan shall be obtained from the COR prior to starting the work.

Testing Laboratory; GA.

Approval of testing facilities shall be based on compliance with ASTM E548, and no work requiring testing will be permitted until the facilities have been inspected and approved by the COR.

Embankment and Backfill Materials; GA.

At least 5 days prior to placement of any material, the Contractor shall submit to the COR the results of all required testing necessary to classify the material and necessary for determining if placement is in compliance with the requirements herein.

Nuclear Density Testing Equipment Operator; GA.

Nuclear density testing equipment shall be used in accordance with ASTM D 2922 and ASTM D 3017. In addition, the following condition shall apply:

a. Prior to using the nuclear density testing equipment on the site, the Contractor shall submit to the Contracting Officer a certification that the operator has completed a training course approved by the nuclear density testing equipment manufacturer.

b. The nuclear density testing equipment shall be capable of extending a probe a minimum of 12 inches down into a hole.

SD-09 Reports

Survey Records; GA.

Submit a copy of the records of each compliance survey the next work day following the survey.

SD-18 Records

Test Results; GA.

Unless otherwise noted, test results shall be furnished the COR within 24 hours of making the test.

SD-13 Certificates

Inspection and Test Results,; GA-RE.

Inspections and test results shall be certified by a registered Professional Civil Engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the Engineer and that the results are representative of the materials or conditions being certified by the tests.

1.4 ACCESS, HAUL ROADS, ROUTING, AND STAGING

The Contractor shall refer to Section, SPECIAL SCHEDULING for construction site access and staging limits. In general and as a minimum, the Contractor shall be required to maintain the access, haul roads (permanent and temporary), routing, and staging areas to prevent dust, rutting, interference with normal traffic flow, litter, and general damage or deterioration. Where a new or existing levee needs to be traveresed, the Contractor is referred to Section, SPECIAL SCHEDULING, paragraphs, "Existing Levee" and "Tie-Back Levees". If levee breaching is not approved, then the Contractor shall construct ramps over the levee as necessary such that the levee section is maintained and not reduced.

1.4.1 Temporary Haul Roads

Temporary haul roads shall be limited to within the project right-of-way as shown on the plans. The Contractor shall include as part of the general plan of operations submittal, the layout and sequencing of the temporary haul roads. Temporary haul roads shall be detailed and constructed according to intended use and shall be maintained in good condition throughout the duration of the construction contract or until the point of construction where the use is no longer required. Temporary haul roads shall not hinder surface run-off or ditch, stream, or river discharges. At the completion of the temporary haul road use, the haul road shall be removed and the area restored to its preconstruction condition or its intended construction condition as required by this construction contract. Temporary haul roads shall not be considered a separate pay item.

1.4.2 Permanent Roads Used as Haul Roads

Permanent roads used as haul roads shall be maintained throughout the duration of use and shall be restored to the pre-construction condition or the intended construction condition.

1.5 MAPPING AND FIELD SURVEYS

Topographic mapping is as indicated on the plan sheets. The Contractor is directed to applicable Plan Sheet for mapping standards by area. Field surveys shall be completed as necessary and shall use the vertical and horizontal control identified within these construction documents.

1.5.1 Layout of Work

The Contractor shall lay out the work as indicated within these construction documents.

1.5.2 Surveys for Quantities

The Contractor shall complete surveys for the purpose of quantifying placed material or excavated materials per the pay items. Surveys shall also be completed to verify complete work to the lines, grades, and requirements specified. Levee overbuilds have been included for anticipated settlement. The Contractor shall plan operations to complete the surveys prior to settlement occurring to the degree of impacting survey results. The survey layout shall be as approved by the COR. Quantities shall be calculated per the average end area method. If the Contractor elects to utilize settlement devices to supplement field surveys, the Contractor shall provide a detailed submittal for COR review, comment, approval, and/or disapproval and shall address the technique, layout, detail drawings, the sequence of effort. There will be no payment for settlement devices.

1.5.3 Surveys for Hillside Borrow Operations

In the event the Contractor elects to use hillside borrow, the Contractor shall complete field surveys satisfactorily to allow quantification of excavated hillside. All breaks and site features shall be surveyed. Following the initial surveys, field surveys shall be completed at the end of each month that borrow occurs to provide intermediate quantities. Prior to conducting a field survey, the Contractor shall provide seven working days notice to the COR. Surveys may be witnessed by the property owner, levee sponsor, and COR. Survey procedure and layout shall be coordinated and agreed to by the COR.

1.6 SOURCES OF FILL MATERIAL

1.6.1 Material Source Usage

A detailed plan of operations shall be submitted for COR review and approval addressing all aspects of material sources to include borrow operations, required excavations, and offsite sources. Material sources usage shall be planned to optimize available material types and ensure sufficient material for each of the defined fill zones. Proposed material usage and distribution shall be included within the plan of operations' submittal. Borrow activities shall not begin until the submittal has been approved by the COR. In general, sources of fill material have been identified for this project and include required excavations, hillside borrow area, and offsite sources. Required excavations and hillside borrow area are sources of impervious and random material. It is anticipated the Contractor will have to locate an offsite source to provide drainage material. Since the same material sources serve as sources of both impervious and random material, the Contractor shall plan extractions, classification, and placement operations to ensure sufficient impervious material for the impervious fill zones. The Contractor shall consider use of impervious classified material for random fill zones on a limited basis to supplement other random sources such as the materials encountered that do not classify as impervious material but are acceptable for random fill zones. If the Contractor elects to use impervious classified material for random fill when there is non-impervious material availble and as a result there is insufficient impervious material for the impervious fill zones, the Contractor shall supplement as necessary additional impervious material necessary to meet the impervious fill zone quantity. The cost associated with supplementing impervious material shall be at no expense to the Government. The Contractor shall use the required excavation for fill with the exception of unacceptable material. In addition, the Contractor will be limited on the quantity of hillside material obtained for this construction. If the Contractor does not fully utilize all the available sources of fill material such that there is insufficient quantity for construction, the Contractor shall be responsible for supplementing material types. Material types supplmented by the Contractor shall be review and approved by the COR prior to use. The Contractor is referred below to the paragraph, "Alternate Material Sources Proposed by the Contractor".

1.6.2 Alternate Material Sources Proposed by the Contractor

The Contractor may submit for review and approval to the COR alternate material sources to supplement fill from required excavations or from partial use of already approved borrow sources. The COR will make the final determination on approval of alternate borrow source or sources. If the Contractor elects to submit an alternate material source or sources, the Contractor shall first coordinate with the COR to obtain Contractor requirements for addressing within the submittal the engineering properties, scheduling of work, impacts to the levee, proximity to the levee, environmental regulations, and cultural regulations. An incomplete material source submittal will be grounds for disapproval. If the initial submittal is disapproved, the Contractor shall not submit additional alternate material sources and shall utilize sources of fill identified within these construction documents. The Contractor may elect to obtain processed material, such as drainage material, and will be considered acceptable subject to meeting the requirements of the construction documents.

1.6.3 Variability of Borrow and Required Excavation Properties

A plan shall be submitted to the COR for review and approval outlining borrow and required excavation extraction and placement within the appropriate fill zones. As a minimum the plan shall address excavation sequence; excavation during unfavorable seasons; segregation and protection of material types; adjustment of moisture content; additives to alter moisture content; efforts to minimize loss of available fill material; and measures to protect the available borrow and required excavation throughout the fill material extraction process. The Contractor shall review all available soils' information to develop an appreciation of the soil properties and the need for efforts to adjust soil properties to meet placement and compaction requirements. Of special concern are the moisture contents and the Contractor's proposed procedure for adjusting the moisture contents to an acceptable level while not wasting the available fill. The Contractor shall also consider and address subsurface moisture content and water table tendencies associated with an adjacent channel or river and a procedure to allow use of materials impacted by these tendencies. The Contractor shall also be prepared to segregate material types, protect the various material types as necessary, and place within the appropriate fill zones. Provisions for adjusting soil properties are further addressed in Part 3, "Execution" of this section.

1.6.4 Required Excavation

Required excavation to be used for fill within the applicable fill zones includes the existing levee that is not within the random zone and/or landside berm of the new levee; Quindaro Pump Station ponding area excavation; ditch excavation; Line Creek excavation; excess material from excavation for construction purposes; and excess material from the inspection trench.

1.6.5 Hillside Borrow

The hillside borrow is comprised of loess and is located in Riverside, Missouri at Northwood Road and Missouri State Highway 9. The Contractor will be limited to acquiring no more than 900,000 in place required density cubic yards. The material shall be obtained from the two norhernmost ridges of the 3 available ridges. This source of fill, up to the 900,000 in place required density cubic yards, will be provided to the Contractor without assessment of a royality fee.

1.7 SUBSURFACE INFORMATION

1.7.1 Available Subsurface Information

Striplogs with select soil laboratory test results are included within the construction plans along with the, "Legend of Logs of Borings". Complete drill and sample logs and laboratory test results may be examined at the Kansas City District Federal Building, Kansas City, Missouri by coordinating with the COR. A minimum of two days advance notice for scheduling purposes shall be provided to the COR.

1.7.1.1 Use of Subsurface Information

Drill, sample, and test results are an indication of the subsurface condition at the location of the boring and tests. Variations in subsurface condition may exist between boring and test locations. Soil

moisture contents and groundwater levels are indication of that information at the time of the measurement, sample extraction, and/or testing. Soil moisture content and groundwater level may vary with time in response to seasonal precipitation and river stage variations. As a result, moisture contents and groundwater levels at the time of construction may differ from the data shown on the drawings.

1.8 SAMPLES FURNISHED TO THE GOVERNMENT

Upon request from the COR and within 4 hours of the COR request, the Contractor shall furnish samples from material sources, placed fill, ongoing construction, and/or completed construction. The specifics of sample acquisition to include method, conditions, quantity, container, and other requirements will be specified by the COR. Contractor shall perform this service at no cost to the Government.

1.9 EXISTING LEVEE

The Contractor is directed to Section, SPECIAL SCHEDULING for existing levee requirements. The existing levee shall not be stripped of vegetation until immediately prior to excavation or incorporation within the construction.

1.10 DRAINAGE AND DEWATERING

1.10.1 Surficial and Pipe Drainage

The Contractor shall address in their general plan of operations the methods of drainage control. The Contractor shall maintain natural drainage patterns and/or designed drainage patterns. Temporary work, such as haul roads, shall be designed and constructed so as not to induce adverse flooding or backwater from general run-off and pipe, ditch, stream, or river discharge. The Contractor shall complete necessary efforts to divert run-off and pipe, ditch, stream, or river discharge away from excavations, fill areas, and general construction. The Contractor shall monitor and make adjustments as necessary.

1.10.2 Dewatering

Where excavation dewatering is necessary, the Contrator shall submit the dewatering plan for COR review that will include as a minimum the dewatering design and the dewatering system layout.

1.11 PROTECTION OF EXISTING FEATURES AND ONGOING OR COMPLETED CONSTRUCTION

The Contractor shall plan and conduct operations to ensure the protection of existing features and ongoing and completed construction. Damages occurring during the course of this construction contract as a result of the Contractor's actions or negligence shall be repaired by the Contractor at no expense to the Government. Analyses, designs, details associated with the repairs shall be prepared by an approved design firm at no expense to the Government. The Contractor shall submit the designs for COR review and shall not begin work until the design has been approved. In some cases the repair may require an upgrade. If the upgrade is at the request of the Government, then the Contractor shall be responsible for the expense of the design in its entirety including the upgraded features. However, the Government will provide an equitable adjustment in cost to cover the expense of the construction associated with the upgrade.

1.11.1 Notification and Coordination

When work is to be completed on an existing feature, adjacent to an existing feature, or any time work is planned that may impact an existing feature or an area activity, the Contractor shall be responsible for coordinating with impacted parties to prevent complications with disrupting service or activity.

1.11.2 Ongoing and Completed Construction

In general, the Contractor shall complete the necessary efforts to protect ongoing and completed construction. Earth fill and exposed cuts shall be protected from construction activity and general erosion. Damages occurring shall be repaired by the Contractor at not expense to the Government. The Contractor shall be responsible for protecting against general erosion and repair thereof until the cover has been placed and in the instance of vegetative cover, until the vegetation has established to the point that erosion cannot occur.

1.11.3 Public Roads, Accesses, and Appurtenances

The Contractor shall plan and complete the necessary efforts to protect public roads, accesses, and appurtenances from damages associated with this construction project. The Contractor is directed to Clause 60, "Permits and Responsibilities" of the "Construction Contract Clauses". Contractor's activities shall not deter public use of the roads, accesses, and appurtenances. At locations where public roads, accesses, and/or appurtenances are damaged or destroyed because of the work required under this contract, the Contractor shall provide temporary facilities until a permanent repair can be completed and the construction operations adjusted to prevent further damage. Temporary facilities shall be removed by the Contractor when the permanent repair is complete. Load limits on the existing roads and bridges shall be coordinated with the State and local Departments of Transportation, private entities, or appropriate governing entity, and the Contractor shall comply with the load limits or complete approved modifications to allow for increased loads.

1.11.4 Environmental and Cultural

The Contractor is referred to and shall comply with the requirements of Section, ENVIRONMENTAL PROTECTION for CIVIL WORKS.

1.11.5 Blasting and Explosives' Storage

Blasting shall not be allowed for this construction project. Explosiives shall not be stored on site for any reason or for any length of time.

1.11.6 Impacts Outside Construction Right of Way

Contractor's work directly or indirectly impacting property not included within the project's construction right of way limits, shall be coordinated with the COR, and proof of Contractor acquired right of way or easements of the impacted real estate or facility shall be provided to the COR 30 days prior to impacting the real estate or facility. Right of way and easement acquisition shall be in accordance with Government practices as directed by the COR.

1.12 PERMITS

For the work within this construction contract the Contractor shall be responsible for coordinating and obtaining all permits required by Federal, state, and local entities other than those identified as already obtained by the Government. The Contractor is referred to Section, "Construction Contract Clauses", Paragraph, "Permits and Responsibilities" and to Section, "Special Scheduling", Paragraph, "Permits".

PART 2 PRODUCTS

2.1 FILL MATERIALS

In general satisfactory materials for the respective fill zones shall consist of those material types defined hereinafter. Random material for the landward berms shall be further defined as material as pervious or more pervious than the soil it is being placed upon. Stabilizing agents, when approved by the COR, shall be considered acceptable material only for the purpose as approved by the COR. Material types defined hereinafter shall be placed in the appropriate fill zones as indicated on the plan sheets and herein these specifications. Unsatisfactory materials for the respective fill zones that do not meet the material types'requirements as defined shall be disposed offsite by the Contractor.

2.1.1 Impervious Material

Impervious material shall consist of fine-grained materials of low permeability consisting of clays, silty clays, and/or silts. Impervious material shall be free of crushed rock, debris, plant growth, roots, and humus. The particle size of impervious material shall shall be such that a minimum of 50 percent of the soil particles pass a U.S. Standard No. 200 sieve. Acceptable impervious material will be CL, CH, and/or ML as classified in accordance with ASTM D 2487.

2.1.2 Pervious Material

Pervious material shall consist of free draining sand, gravely sand, sandy gravel, and/or gravel. Pervious material shall be sound durable particles and shall be free of plant growth, roots, humus, debris, and deleterious substances. The particle size of pervious material shall be such that not more than 5 percent of the materials pass the U.S. Standard No. 200 sieve as determined with a washed gradation test. Acceptable pervious material will be SW, SP, GW, and/or GP as classified in accordance with ASTM D 2487.

2.1.3 Drainage Material

Drainage material to facilitate seepage adjacent pipes and structures shall consist of free draining fine to medium sand. Drainage material shall be sound durable particles and shall be free of plant growth, roots, humus, debris, and deleterious substances. The particle size shall be such that 100 percent of the materials passes the U.S. Standard No. 10 sieve and not more than 5 percent of the materials pass the U.S. Standard No. 200 sieve as determined with a washed gradation test. Acceptable pervious material is SP as classified in accordance with ASTM D 2487.

2.1.4 Random Material

Random material shall consist of, as defined hereinbefore, impervious material, pervious material, drainage material, or any combination thereof.

2.1.5 Topsoil Material

In general, topsoil material shall be material organic in nature and capable of sustaining the specified vegetative growth. Topsoil material shall be the material stripped in preparation of the fill, excavation, or general construction. Stripped material is addressed within Section, CLEARING, GRUBBING, and STRIPPING. Topsoil from offsite sources, proposed by the Contractor and approved by the COR, shall be supplemented as necessary when there is insufficient acceptable on-site sources. Topsoil material shall be free from clay lumps, weeds, litter, brush, matted roots, toxic substances, or any material harmful to plant growth or which would hinder grading, planting, operation, or maintenance operations. Topsoil material shall not contain more than 5 percent by volume of stones or other such objects larger than 1 inch in any dimension. Topsoil material shall be such that a minimum of 50 percent of the soil particles pass a U.S. Standard No. 200 sieve.

2.1.6 Aggregate Surfacing

Aggregate surfacing shall conform to Section, "Aggregate Surface Course".

2.1.7 Riprap

Riprap shall conform to Section, STONE PROTECTION.

2.1.7 Bedding

Bedding shall conform to Section, STONE PROTECTION.

PART 3 EXECUTION

3.1 GENERAL

All work shall be in compliance with the requirements of the construction documents including approved submittals.

3.1.1 Dewatering and Run-off Control

Where dewatering and/or run-off control is necessary, the Contractor shall submit all design and plans for COR review. Surface and groundwater control shall be accomplished as necessary in coordination with the required excavation and embankment construction. Run-off control shall also include control of discharges from pipes either currently discharging or discharging as a result of being severed. Surface water and/or groundwater control may necessitate the use of temporary diversion ditches, cofferdams, bypass systems, and/or pumping from wells, well points, and/or sumps.

3.1.2 SHORING, SHEETING, AND BRACING

Where excavation or fill support is necessary to support earth, protect adjacent features, or maintain worker safety, the support system shall be designed in accordance with Federal levee criteria and submitted for COR approval. Reference Section, SPECIAL SCHEDULING for Federal levee criteria. Design shall be completed by a registered professional engineer with experience in this kind of work. In addition to Federal levee criteria, the design shall be in compliance with EM 385-1-1. Shoring, sheeting and bracing shall not be used in lieu of the required excavation slopes where there is sufficient space for cut back slopes. Unless otherwise directed, the design and submittal shall also address removal of

the excavation or fill support. With the exception noted above, all shoring, sheeting and bracing shall be removed as embankment and backfill operations progress and the void filled by a COR approved method.

3.1.3 Freeboard Gages

Freeboard gages shall be constructed per the schedule and to the details included within the plan sheets. Earthwork shall follow the detail and note requirements on the plan sheets.

3.2 REQUIRED EXCAVATION AS A SOURCE OF FILL AND BORROW OPERATIONS

Sources of fill material as pertains to borrow operations are identified in Part 1, "General" of this Section. Excavation for borrow operations shall not be considered a separate pay item. Borrow operations shall be completed to the lines, grades, and requirements in accordance with the construction documents and approved submittals. Required excavation as a source of fill and borrow approved submittals shall be altered as necessary to meet conditions encountered on site as the work progresses. Submittal changes shall first be approved by the COR prior to implementing the changes. Excavation shall not occur until utilities have been located.

3.2.1 Hillside Borrow

For the most part hillside borrow has been cleared, grubbed, and stripped. The Contractor may have to complete some minor stripping prior to excavation of material. Excavation shall be completed such that the entire two northermost ridges of the three available are excavated maintaining a relatively flat surface with only a slight slope for drainage. Drainage shall be in the direction of natural slope and where erosion structures are in place. Existing erosion structures shall be maintained by the Contractor and any necessary additional erosion structures shall be be constructed and maintained by the Contractor. The Contractor shall coordinate with the COR as to the procedure, sequence, and excavation configuration at the perimeter of the two northernmost ridges. At the completion of borrow excavation, the site shall be left in a stable state with all necessary erosion structures left in-place.

3.2.2 Clearing, Grubbing, and Stripping

Clearing, grubbing, and stripping shall be in accordance with the Section, CLEARING, GRUBBING, and STRIPPING. The Contractor is directed to the paragraph referencing stripping and use as topsoil.

3.2.3 Variability of Material Properties

The Contractor shall review all available soil information to develop an appreciation of the material variablity and the necessity to adjust soil properties especially with respect to the material types and high moisture contents. Variable material types shall require classification, segregation, stockpile, and placement within the appropriate fill zone. High moisture contents shall require the Contractor to complete efforts to adjust the moisture contents to within an accepatable range. In addition, the hillside borrow area is a loess material and will be sensitive to wetting. Compaction curves for the loess may demonstrate a narrow band to achieve compaction and therefore necessitating the need for tight moisture control requirements. The Contractor shall submit a detailed plan to the COR for review of how the observations identified above as well as other issues associated with material acquisition and placement will be addressed

during construction. The plan shall propose procedures that minimize wasting of material.

3.2.3.1 Moisture Content Adjustment--General

The Contractor shall develop a plan for adjusting moisture contents of the available fill material to achieve the proper placement and compaction. Pervious material shall be 100 percent saturated during placement and compaction. Moisture contents for impervious material may require air drying or additives for moisture content reduction or sprinkling and mixing to increase the moisture content. Contractor may propose alternative methods to adjust moisture contents. The submittal shall include in detail the planned procedures. Adjustement of moisture content shall not be an added expense to the Government.

3.2.3.2 Moisture Content Adjustment--Air Dry

The Contractor may reduce the moisture content by staging operations to allow spreading of material and disking the soil to expose it to air and sun. The submittal shall address such tasks as efforts to acquire the wet material from the source, source sequencing, location of spreading, procedure to avoid crusting of the spread soil or exposed source surface, plan to avoid introduction of moisture from rainfall, continuous aeration, seasonal complications, and transfer of material to the fill zone. The submittal shall also address in detail staging, equipment, and anticipated results. The excavation of wet material from material sources shall be limited to those techniques that do not create an adverse condition in the excavation area, such as would be the case if equipment became bogged down within the excavation area or if the excavation area condition between successive excavations did not promote surface runoff.

3.2.3.3 Moisture Content Adjustment--Admixtures

The Contractor may reduce the moisure content by mixing additives within the wet soil. The submittal shall address in detail as a minimum the procedure, equipment, mixture, and case studies where used before (under similar circumstances). Applicable requirements considered within the air dry option shall also be included within this submittal. The use of fly ash or other drying agents, approved by the COR, may be proposed by the Contractor. The submittal shall also include moisture-density curves developed for the material types and admixture percentage. The moisture-density curve for the fill with the admixture (drying agent) shall be used to establish the maximum dry density and optimum moisture content for the fill type with the drying agent incorporated. Adjustments in the drying agent will constitute a different fill material type and will be subjected to the required testing.

3.2.4 Frozen Material

Frozen material shall be considered unacceptable for fill material. Frozen material shall either be removed and used at a later date when thawed and the moisture content sufficiently adjusted or shall be thawed and the moisture content adjusted to within the acceptable range prior to use as fill.

3.3 EXCAVATION OPERATIONS

Excavation shall consist of removal to the lines and grades shown on the

plan sheets and as directed herein and the handling to include stockpiling, loading, hauling, and/or placement as required. Exacavations shall be maintained free of debris of any sort or deposited material. Excavations shall be protected from surface runoff. Excavation drainage and dewatering shall be coordinated as required by these construction documents to include approved submittals. Excavation shall not be initiated until utilities have been cleared.

3.3.1 Clearing, Grubbing, and Stripping

Clearing, grubbing, and stripping shall conform to Section, CLEARING, GRUBBING, and STRIPPING. Disposition of cleared, grubbed, and stripped material shall be in accordance with the requirements of these construction documents. Where disposition is not provided for, the Contractor shall be responsible for proper disposition. The Contractor is directed to the paragraph below providing an option for clearing and grubbing disposition.

3.3.2 Required Excavations

Material from required excavation available for fill shall be placed and compacted within the appropriate fill zone per the requirements for placement. The use of the existing levee is addressed within Section, SPECIAL SCHEDULING.

3.3.3 Quindaro Pump Station Ponding Area

3.3.3.1 Ponding Excavation

The Quindaro Pump Station ponding area shall be excavated to the lines, grades, and elevations indicated within the drawings. The excavated material shall be used as fill in the appropriate fill zones identified for this construction contract.

3.3.3.2 Ponding Area Over-Excavation

The Contractor may over-excavate the ponding area for the purpose of obtaining additional fill material or for creating a dump site to dispose construction debris that is not considered hazardous and toxic; and cleared and grubbed material that is not considered hazard and toxic. Regardless of the material disposed, it shall not be disposed in the base of the over-excavatoin unless the disposition in this matter meets all local, state, and Federal requirements. Disposed material placed at the base of the over-excavated ponding area shall be left in a stable state and approximate the grades shown at the base of the ponding excavation. Over-excavated material is the responsibility of the Contractor to either place in the appropriate fill zones or dispose in an approved manner. The over-excavation slopes shall coninue with the slopes of the ponding excavation, however, a bench equal in width to the over-excavation height shall be maintained around the perimeter of the ponding area and at the elevation of the ponding area base as shown in the drawings. The bench shall be slightly sloped to drain towards the center of the ponding area. Disposing of material within the over-excavation shall not rise to an elevation greater than the ponding area bottom elevation shown in the drawings. If the Contractor elects to over-excavate the ponding area, a detailed plan shall be developed to include drawings, details, and procedure for the work demonstrating a methodical and stable excavation and filling.

3.4 [Enter Appropriate Subpart Title Here]3.4.1 Inspection Trench

The inspection trench shown within the plan sheets is a required excavation. The inspection trench shall be required throughout the length of the levee and shall be excavated to the lines and grades shown on the drawings. Prior to beginning work, the Contractor shall submit a plan of operations addressing trench excavation layout, staged limits, sequencing, methods of maintaining a dry excavation, and backfill operations. A coordination plan for other operations such as layout of utility and other subsurface features' locations, procedures for excavating, discovering, and documenting unknown utilities or subsurface features, and segregation of excavation and backfill plan shall be included. Work shall not begin until the plan of operations has been approved by the Contracting Officer. The inspection trench shall be excavated in such a fashion as to prevent damage to utilities and other subsurface features. Excavated materials shall be selectively separated by material classification and protected. Once the inspection trench has been inspected by the Contractor and the Contracting Officer, it shall be backfilled with impervious material in accordance with the requirements herein. Material excavated that is not classified as impervious shall be utilized in construction within the appropriate zone. Excavated materials and items that are unacceptable for re-use on this project shall be the responsibility of the Contractor and removed from the site.

3.4.2 Excavation for Structures and Pipes

Excavations for structures shall conform to the dimensions and elevations indicated for each structure and footing, except as specified hereinafter, and shall include trenching for utility and foundation drainage systems. Excavations for structures shall conform to SECTION, EXCAVATION, TRENCHING, BACKFILLING FOR UTILITIES SYSTEMS, AND STRUCTURES. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government and filled in accordance with the requirements herein. Over excavation below required invert elevations or bottoms of footings shall be backfilled with satisfactory material compacted to the density of the surrounding undisturbed material at no additional cost to the Government. No footings shall be constructed on unsatisfactory material as determined by the COR. Excessively wet and/or soft material in subgrades resulting from water ponding in footing excavations shall be removed and replaced with satisfactory material compacted to the density of the surrounding undisturbed material.

3.4.3 Excavations for Relocations

In general excavations for relocations shall conform to Sections, EXCAVATION, TRENCHING, BACKFILLING for UTILITIES SYSTEMS, and STRUCTURES and SPECIAL SCHEDULING and as required herein these specifications and plan sheets. Pipe placement shall be completed such that the fill is placed to an elevation and then shaped for the pipe diameter such that 60% of the horizontal pipe diameter is bedded into the shaped fill. The practice may be labor intensive especially when occurring in impervious materials. The Contractor shall demonstrate satisfactory completion. Shaped fill and pipe placement shall be inspected by the COR prior to continued backfill operations. Additional shaping shall be required where irregularities occur such as pipe joints and connections.

3.4.4 Excavation for Bedding and Riprap

Excavations for bedding and riprap shall be completed to the layout, lines, and grades shown in the plan sheets.

3.4.5 Excavation for Ditching

Excavation for drainage ditches shall be to the layout, lines, and grades shown in the plan sheets or as directed herein.

3.4.6 Excavation Slopes and Surcharges

Excavation slopes shall be to the grades shown on the plan sheets or as directed herein. Under no circumstances, temporary or permanent, shall the slopes be steeper than the slopes required. Some excavations shall require the Contractor to construct a bench within the slope. The Contractor shall not surcharge the excavation with excavated or stockpiled material, construction equipment, or general loading. Slides or other adverse consequences caused by failure of the Contractor to comply or in general perform operations in a reasonable manner shall be considered the responsibility of the Contractor and repaired by the Contractor as approved by the COR at no additional expense to the Government. If the slide or other adverse consequence is due to no fault of the Contractor, the repair shall be completed as approved by the COR and an equitable adjustment in the contract price will be made for the repair in accordance with the Construction Contract Clause, "Changes".

3.4.7 Over Excavations

3.4.7.1 Over Excavations Outside the Limits of the Levee and Berm Foundation

Over excavation outside the limits of the foundation of the levee and/or berm (or structure or pipe within the levee alignment) shall be backfilled to grade with similar materials or a COR approved alternate material and compacted to a density of at least that of the surrounding undisturbed material or if an alternate material is approved, to the density required for that material type.

3.4.7.2 Over Excavations Within the Limits of the Levee and Berm Foundation

Over excavation within the limits of the foundation of the levee and/or berm (or structure or pipe within the levee alignment) shall be backfilled to grade with impervious material in accordance with the compaction requirements herein.

3.4.8 Excavation Tolerances

A tolerance of 6 inches above or below the prescribed grade will be allowed in the excavation for ditches, inspection trenches, excavations for bedding and riprap. Excavation tolerances shall not be allowed where excavation is for a structure or pipe.

3.4.9 Stockpiles for Excavated Material

Where excavated material is to be used for fill of the construction of this project, the Contractor shall either place and compact as the material is being excavated or stockpile the material until ready for use. Stockpiled material shall be placed such that any part of the stockpile is no closer to the excavation than a distance equal to the depth of the excavation. Stockpiled material placed the minimum distance from the excavation shall not be higher than the adjacent excavation depth and shall maintain the

slope of the excavation. The slope of stockpiled material placed a stable distance from the excavation as approved by the COR shall be no steeper than that what is allowed in the EM 385-1-1. Stockpiles shall be protected from contanimation of differing materials, natural occurrences, and general construction activities.

3.5 FILL OPERATIONS

In general, fill operations shall conform to the requirements herein these construction documents and approved submittals. The methodology shall primarily be a procedural specification with specific material properties maintained within a specified range or limit. However, specified testing shall be required to verify the specified ranges or limits are met and to verify adequacy of the procedure. If the specified ranges and limits are met and the procedure doesn't deliver the defined compaction results, then an adjustment in the procedure may be specified and an equitable adjustment made in the price to the Contractor or in lieu of this, the COR may adjust the compaction values. If the specified ranges and limits and/or procedure are not met, then the Contractor shall adjust the operations for compliance and the fill reworked at no additional cost to the Government.

3.5.1 Limits of Fill Operations

Fill shall be placed to the lines and grades and within the appropriate fill zone as indicated within the plans and as stated herein this section. Only approved materials as defined herein shall be placed in the appropriate fill zones. Topsoil shall be placed within the fill lines indicated on the plan sheets per the requirements herein. Unsatisfactory materials shall be the responsibility of the Contractor for disposition. The Contractor shall place fill in such a manner as to prevent mixing of material types especially at the fill zones' interfaces.

3.5.2 Surface Preparation for Fill Placement

Clearing, grubbing, stripping, and/or general excavation shall be completed as required prior to any fill operations. Fill shall not be placed on the embankment foundation until the area to receive the fill has been inspected and approved by the COR. Surfaces subjected to fill to include prepared ground surface and the previous placed lift shall be thoroughly scarified to a depth of 3 inches. Scarified surfaces compacted prior to placement of the subsequent lift shall be re-scarified. Fill shall be placed in layers and compacted in accordance with the provisions for the specific material type required herein. Where necessary the moisture content shall be adjusted for the scarified soil or the fill to be placed. Surfaces shall be graded to drain.

3.5.2.1 Proof Rolling and Grubbed Areas

Once a site is cleared, grubbed, stripped, and/or excavated, the site shall be proof rolled to locate loose, saturated, or soft zones. Loose and soft zones shall be removed and disposed. Cuts such as grubbed areas or topography that is abrupt with steepened sides shall be excavated to flatten the steepened sides. Surfaces subjected to fill shall be thoroughly scarified prior to placing fill.

3.5.2.2 Removal of Unsatisfactory Materials

Prior to placement of fill, materials within the surface to receive fill that do not meet the material requirements as specified herein or have been

subjected to conditions such as saturating rain or freeze conditions, shall be removed prior to placement of fill.

3.5.2.3 Benching

When fill is to be placed against an embankment such as the existing levee or placed fill, the Contractor shall bench into the embankment to facilitate fill placement. The vertical face of the bench shall be approximately the compacted lift thickness of the adjacent fill.

3.5.3 Placement of Fill

In general, placement of fill shall be in accordance with the requirements of the specifications and to the lines and grades shown on the drawings. Where vegetative cover is scheduled, topsoil shall be placed within the limits of the lines and grades of the plan sheets but not to exceed the specified topsoil fill thickness indicated hereinafter. The Contractor shall note zones call outs for a specific material type shall have topsoil within the finish fill lines where vegetative cover is scheduled.

3.5.3.1 LEVEE FILL VARIATION

In general, when varying approved material types are placed within a levee embankment fill zone, the fill shall be placed as a spectrum with the least pervious at the riverward extent of the fill zone and the most pervious at the landward extent of the fill zone. Placement practices throughout each fill zone of the levee shall be such that the embankment will be free from lenses, pockets, streaks, and layers of material differing substantially in texture, gradation, or classification from surrounding material of the same material type. If within the same material type lenses, pockets, streaks, or layers are encountered, the Contractor shall spread and mix the materials by a COR approved method in order to form a blend of the materials.

3.5.3.2 Fill Tolerances

Fill areas shall be constructed to the grades, lines, and cross sections shown on the plan sheets and as directed herein. At all points, a tolerance of 4 inches above or below the prescribed fill elevation will be permitted provided the grade prevents ponding on the embankment or fill and there are no humps, depressions, or abrupt changes in grade other than those indicated in the plan sheet details. Fill tolerances shall not be allowed where fill is required to support a structure or pipe.

3.5.3.3 Impervious Material

Impervious material to be placed in an impervious fill zone shall be placed and spread in a layer not more than an 8 inch loose lift thickness, except the loose lift thickness shall be reduced to 6 inches when within 4 feet of a structure or pipe or when placing within an area is inaccessible to large equipment. To the extent possible, layers should encompass the entire impervious fill zone section and should be carried substantially horizontal and parallel to the levee centerline with slight grade to provide satisfactory drainage during construction.

3.5.3.4 Pervious Material

Pervious material to be placed in a pervious fill zone shall be placed and spread in a layer not more than an 8 inch loose lift thickness, except the

loose lift thickness shall be reduced to 6 inches when within 4 feet of a structure or pipe or when placing within an area inaccessible to large equipment. The landside underseepage berm shall be comprised of random fill and topsoil as required herein these construction documents. Pervious material to be placed within the pervious fill limits of the landside underseepage berm, may be placed in a 12 inch loose lift thickness. Sequencing of work shall provide for placement of the required lift thickness throughout the limits of the fill section and provide for lift thickness complete saturation while at the same time allow for drainage with time. Layers should be carried substantially horizontal and parallel to the levee centerline with sufficient features to facilitate drainage during construction without violating the levee section requirements.

3.5.3.5 Drainage Material

Drainage material to be placed in the fill zone adjacent to a pipe or structure to facilitate controlled seepage, shall be placed and spread in a layer not more than a 6 inch loose lift thickness. Drainge material shall be placed to ensure complete placement and compaction below, adjacent, and above the pipe or structure.

3.5.3.6 Random Material

Random material to be placed in a random fill zone shall be placed in accordance to the material the random is comprised of--impervious or pervious.

3.5.3.7 Topsoil Material

Topsoil material to be placed within the outer face of the appropriate fill surface and shall be placed as follows: fill zones comprised of pervious material shall have 12 inches of topsoil placed to the finish grade shown on the plan sheets. Fill zones comprised of impervious material shall have 6 inches of topsoil placed to the finish grade shown on the plan sheets. Topsoil shall only be placed where vegetative cover is scheduled. Topsoil shall not be placed in more than an 8 inch loose lift thickness.

3.5.3.8 Aggregate Surfacing, Bedding Rock, and Riprap

Aggregate surfacing, bedding rock, and riprap shall be placed in accordance with Sections, "Aggregate Surface Courses" and STONE PROTECTION.

3.5.3.9 Fill Placement Adjacent to a Structure or Pipe

Fill shall not be placed on or against concrete less than 7 days after concrete placement or when the concrete is less than 70 percent of the design strength. Placement of fill against structures and pipes shall conform to SECTION, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES. Crawler-type tractors, vibratory equipment and other similar compaction equipment shall not be used within 4 feet of any completed or partially completed structure or pipe. Compaction within 4 feet of completed or partially completed structures and pipes shall be accomplished by the use of mechanical hand tampers, vibrating plates, or other approved methods and equipment. The Contractor shall ensure that compaction operations do not damage any existing utility, structure, or pipe. Any damage caused by the Contractor's operation shall be repaired at no additional cost to the Government.

3.5.4 Compaction Requirements

In general, compaction shall be a procedural requirement with testing requirements for verification and field adjustments. In some instances, compaction requirements shall be an end product thus producing a specified minimum density. An example is, required minimum densities specified shall be achieved for compaction below, adjacent, and above a pipe or structure regardless of compaction procedure.

3.5.4.1 Impervious Material Within Levee Slopes Projected

Impervious material placed within the levee embankment slopes projected shall be compacted as required herein. With the specified loose lift thickness and moisture content, each lift shall be compacted with a minimum of 6 complete passes of an approved tamping roller. The rolling shall be completed parallel to the levee centerline, pipe, or structure. Compaction testing shall be completed as required hereinafter and a minimum of 95% of the Standard Proctor maxium dry density shall be achieved. If the minimum compaction is not achieved, placement shall be discontinuted until the COR makes a determination. If the dumped impervious material requires breaking up, then the Contractor shall propose a procedure and shall be approved subject to satisfactory demonstration of effectiveness. In areas inaccessible to large construction equipment or below, adjacent, or above a structure or pipe, placement and moisture content shall be as indicated herein these specifications, and compaction shall achieve 95% of the Standard Proctor maximum dry density.

3.5.4.2 Impervious Material Outside Levee Slopes Projected

Impervious material placed outside the levee embankment slopes projected (such as the riverside berm) shall be compacted as required herein. With the specified loose lift thickness and moisture content, each lift shall be compacted with a minimum of 4 complete passes of an approved tamping roller. The rolling shall be completed parallel to the levee centerline, pipe, or structure. Compaction testing shall be completed as required hereinafter and a minimum of 90% of the Standard Proctor maxium dry density should be achieved. If the minimum compaction is not achieved, placement shall be discontinued until the COR makes a determination. If the dumped impervious material requires breaking up, then the Contractor shall propose a procedure and shall be approved subject to satisfactory demonstration of effectiveness. In areas inaccessible to large construction equipment or below, adjacent, or above a structure or pipe, placement and moisture content shall be as indicated herein these specifications, and compaction shall achieve 95% of the Standard Proctor maximum dry density.

3.5.4.3 Pervious Material

Pervious material placed as part of this construction contract shall be compacted as specified herein. With the specified loose thickness and percent saturation, each lift shall be be compacted with 4 complete passes of an approved vibratory roller or plate compactor. The roller or plate compactor shall be applied parallel to the levee centerline, pipe, or structure. Compaction testing shall be completed as required hereinafter and a minimum of 50% relative density should be achieved. If the minimum compaction is not achieved, placement shall be discontinued until the COR makes a determination. In areas inaccessible to large construction equipment or zones below, adjacent, or above a structures or pipe, placement and percent saturation shall be as indicated herein these specifications, and compaction shall achieve a minimum of 50% relative density.

3.5.4.4 Random Material

If Random material consists of impervious materials, then compaction shall conform to requirements for impervious material. If random material consists of pervious material, then compaction shall conform to requirements for pervious material.

3.5.4.5 Drainage Material

Drainge material compaction shall comply with the requirements for pervious material.

3.5.4.6 Topsoil Material

Topsoil shall be compacted by one pass over each 8 inch loose lift thicknes with a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller.

3.5.4.7 Aggregate Surface, Rock Bedding, and Riprap

Placement and compaction requirements, when applicable, for aggregate surfacing, rock bedding, and riprap shall be in accordance with Sections, "Aggregate Surface Courses" and STONE PROTECTION.

3.5.5 Moisture Control

Materials being placed as fill shall be within the moisture content limits for the respective material type. Materials that are not within the specified moisture content limits either before or after compaction shall be reworked and the moisture content adjusted to obtain a moisture content within the specified range. Surfaces to receive fill shall be monitored for moisture content. Whenever the surface to receive fill is either too dry or too wet, the moisture content of the surface shall be appropriately adjusted prior to placing the next fill lift.

3.5.5.1 Impervious Material

The moisture content for impervious material to be placed in a fill zone shall be within the range of 3 percentage points above optimum moisture content to 2 percentage points below Optimum moisture content. Moisture content shall be determined per ASTM D 698.

3.5.5.2 Pervious Material

The moisture content for pervious material to be placed in a fill zone shall be fully saturated. The Contractor shall take the measures necessary to assure complete saturation.

3.5.5.3 Random Material

The moisture content for random material to be placed in a fill zone shall be in accordance to the random material per its classification--Impervious or Pervious.

3.5.5.4 Topsoil Material

The moisture content for the topsoil material to be placed shall be such that compactive effort is kept to a minimum yet sufficient to hold the soil

together and support vegetative cover.

3.6 EARTHWORK CONSTRUCTION EQUIPMENT

Earthwork construction equipment intended for the tasks identified hereinafter shall comply with the requirements specified.

3.6.1 Compaction Equipment

3.6.1.1 Towed Tamping Rollers

Towed tamping rollers shall be used for compaction of impervious material. Tamping rollers shall consist of a heavy duty double drum unit, with a drum diameter not less than 60 inches, and an individual drum length of not less than 60 inches. The drums shall be capable of being ballasted with water or a combination of sand and water. Each drum shall have staggered feet uniformly spaced over the cylindrical surface such as to provide approximately three tamping feet for each two square feet of drum surface. The tamping feet shall be 7 to 9 inches in clear projection from the cylindrical surface of the roller and shall have a face area of not less than 5 square inches nor more than 7 square inches. The roller shall be equipped with cleaning fingers, so designed and attached as to prevent the accumulation of material between the tamping feet, and these cleaning fingers shall be maintained at their full length throughout the periods of use of the roller. The weight of the roller shall not be less than 3500 pounds per foot of linear drum length weighted, and shall not be more than 2000 pounds per foot of drum length empty. The two drums comprising one roller unit shall be yoked such that they will oscillate when traversing uneven surfaces. The design and operation of the tamping roller shall be subject to the approval of the COR who shall have the right at any time during the prosecution of the work to direct such repairs to the tamping feet, minor alterations in the roller and variations in the weight as may be found necessary to secure optimum compaction of the earth fill materials. The Contractor may be required to add ballast to the roller to the maximum capacity specified by the manufacturer of the roller. The roller shall be drawn by a crawler-type or a rubber-tired tractor at a speed not to exceed 3.5 miles per hour. The use of the rubber-tired tractor shall be discontinued if the tires leave ruts that prevent uniform compaction by the tamping roller. If tamping rollers are used in tandem, not more than two rollers in tandem will be permitted and in such case, one trip of the tandem rollers over any surface will be considered as two passes. When tamping rollers are used in tandem, the tamper foot spacing shall be offset so that the circumferential rows on the rear drums are in line with the mid-point of the circumferential rows on the forward drums.

3.6.1.2 Self-Propelled Tamping Rollers

Self-propelled tamping rollers may be used in lieu of towed tamping rollers provided the foot pressure on the tamping feet of the self-propelled roller are approximately the same as the foot pressure on the towed roller. For self-propelled rollers steered with rubber-tired wheels, the tire pressure shall not exceed 40 pounds per square inch. Self-propelled rollers shall be operated at speeds not exceeding 3.5 miles per hour. The Contracting Officer has the authority to limit or eliminate the use of self-propelled rollers if they are found to cause shearing or laminations of the compacted fill.

3.6.1.3 Vibratory Rollers

Vibratory rollers shall be used for compacting pervious materials in random fill, drainage fill, and aggregate surfacing. Vibratory rollers shall be equipped with a smooth steel compaction drum and shall be operated at a frequency of vibration during compaction operations between 1100 and 1500 vpm. Vibratory rollers may be either towed or self-propelled and shall have an unsprung drum weight that is a minimum of 60 percent of the rollers' static weight. Towed rollers shall have at least 90 percent of their weight transmitted to the ground through the compaction drum when the roller is standing in a level position hitched to the towing vehicle. Rollers for compacting rockfill, sand and gravel fills, or filter and drainage layers shall have a minimum static weight of 20,000 pounds, a minimum dynamic force of 40,000 pounds when operating at 1400 vpm, and an applied force not less than 9,000 pounds per foot of compaction drum length. Rollers for compacting sand and gravel fills or filter and drainage layers shall have a minimum static weight of 8,000 pounds, a minimum dynamic force of 16,000 pounds when operating at 1400 vpm, and an applied force not less than 5,000 pounds nor greater than 9,000 pounds per foot of compaction drum length. The level of amplitude and vibration frequency during compaction will be maintained uniform throughout the embankment zone within which it is operating. Rollers shall be operated at speeds not to exceed 1.5 mph. The equipment manufacturer shall furnish sufficient data, drawings, and computation for verification of the above specifications, and the character and efficiency of this equipment shall be subject to approval by the COR.

3.6.1.4 Hand Operated Power Tampers

In areas where large equipment is not allowed or it is impracticable to use a roller, compaction shall be performed by the use of approved hand operated power tampers. Hand operated power tampers shall be used for compaction impervious materials and shall be capable of compacting material in a confined area. The compactors shall be either an internal combustion or pneumatic activated tamper. Tampers shall have sufficient weight and striking power to produce the specified compaction. The character and efficiency of this equipment shall be subject to the approval of the COR. Where hand operated equipment is used, compaction shall be a performance specification achieving the minimum compaction requirements.

3.6.1.5 Hand Operated Vibratory Plate

In areas where large equipment is not allowed or it is impracticable to use a vibratory roller, compaction shall be performed by the use of an approved hand operated vibratory plate. Hand operated vibratory plates shall be used for compaction of pervious materials and shall be capable of compacting material in a confined area. Hand operated vibratory plates shall utilize the oscillating cam principal and shall deliver an impact of not less than 2000 pounds and be rated to deliver 2000 impulses per minute. The character and efficiency of this equipment shall be subject to the approval of the COR. Where hand operated equipment is used, compaction shall be a performance specification achieving the minimum compaction requirements.

3.6.1.6 Crawler Type Equipment

Crawler type equipment shall only be used for compaction if there is continuous successful demonstration of achieving compaction requirements. Crawler equipment shall weigh not less than 40,000 pounds and shall exert a unit tread pressure of not less than 6 pounds per square inch. Speeds shall not exceed 3.5 miles per hour.

3.6.2 Wetting Equipment

Wetting equipment shall consist of tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities and rates to variable surface widths. Wetting equipment approval shall be based on demonstration of satisfactory performance. Wetting equipment types and operations shall not compact or excessively wet the material to receive the moisture and shall not result in standing water within the material to be wetted or areas adjacent the staging or construction areas.

3.6.3 Materials' Manipulation Equipment

Scarifiers, discs, spring-tooth or spike-tooth harrows, spreaders, and other equipment shall be suitable for use in manipulating materials in preparation of use in construction. Equipment shall be subject to approval by the COR and shall be based on demonstration of satisfactory performance. Equipment used for blending materials shall be capable of penetrating the full thickness or capable of processing the full thickness of the material. Satisfactory performance shall be based on consistent complete and thorough processing of the material or materials.

3.6.4 Other Earthwork Equipment

Other Equipment not mentioned such as equipment for earthwork extraction and handling shall be subject to COR approval, and approval shall be based on continued satisfactory performance. When conditions change, equipment changes may be required. The Contractor shall be made aware of conditions specific to a flood plain with a fluctuating river adjacent to the work. The Contractor shall consider operational (or trafficability) problems such as, but not limited to, pumping of water and materials to the surface by moving equipment as well as bogging of equipment in soft, wet ground. Selection and proposal of equipment in the plan of operations shall account for ground conditions associated with floodplains near a fluctuating river.

3.7 MATERIALS' TESTING

In general, the requirements specified herein are the minimum requirements. Additional testing shall be required when there is question on the material or fill placed or change of conditions occurring that may impact the material or placed fill. Additional testing shall be performed by the Contractor at no additional expense to the Government.

3.7.1 Classification Testing

Soil classification tests shall be performed in accordance with ASTM D 2487. One classification test shall be required for each representative type of material to be used as fill and for each material type encountered within a borrow area or required excavation. As prescribed in ASTM D 2487, grain size analyses in accordance with ASTM D 422 and Atterberg limits in accordance with ASTM D 4318 shall be performed on each different type of material to be used and for each borrow area. The Contractor shall perform additional tests at the request of the COR. Soil classification tests shall be performed on foundation material as required to determine the acceptability of the in-situ soils. Additional tests shall be required if noticeable changes in the material are observed.

3.7.2 Impervious Material

In general testing frequency specified is applicable for embankment fill and sources of material. When fill is to be placed below, adjacent, or above a pipe or structure, testing shall be completed for every other lift thickness and a minimum of every 500 feet of fill placement.

3.7.2.1 Moisture-Density Test

The moisture-density relationship for each type of impervious material encountered within each of the borrow areas or required excavations shall be determined in accordance with ASTM D 698. Prior to placing any impervious fill material, a (5) five-point (minimum) compaction test shall be performed on the representative samples of the material to be used as fill. Additional tests shall be required each time a new material is encountered. The moisture-density curves shall be compiled to form a family of curves which will be utilized to estimate optimum properties (maximum dry density and optimum moisture content) to be used with field density test.

3.7.2.2 Moisture Content Test

Determination of moisture content shall be performed in accordance with ASTM D 2216. One moisture content test shall be performed for each 1000 cubic yards of material placed or each lift of material whichever is less. Backfill and fills not meeting the required specifications for moisture content shall be retested after corrective measures have been applied. When conditions exist throughout the placement process such as drying winds or sun or wetting from precipitation, additional testing shall be completed throughout the placement process to ensure proper moisture content. The COR shall determine the frequency of additional testing.

3.7.2.3 In-Place Density Test

Impervious fill in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, ASTM D 2922. At least one (1) in-place density test shall be performed on each lift of material or every 1000 cubic yards of completed fill whichever is more frequent with the horizontal locations randomly staggered in the fill. The results of the five-point compaction test and the moisture content test will be utilized to obtain the optimum properties to compare to the results of the in-place density test. Placed fill not meeting the required specifications for in-place density shall be retested after additional compaction has been completed. When the nuclear method is used for in-place density testing according to ASTM D 2922 and ASTM D 3017, the first test and every tenth test thereafter for each material type shall include a sand cone correlation test in accordance with ASTM D 1556. The sand cone test shall be performed at the location of the nuclear test and should sample the same location that the nuclear probe and detector tested, ie as close a distance as possible between the probe and the detector. The sand cone test shall include a nominal 6 inch diameter sand cone, and shall include a minimum wet soil weight of 6 pounds extracted from the hole. Nuclear density testing equipment shall not be used during rain. The density correlations shall be submitted with test results. Each transmittal including density test data shall include a summary of all density correlations for the job prepared on a summary sheet including as a minimum:

Meter serial number and operators initials.
Standard Count for each test.
Material type.

Probe depth.
Moisture content by each test method and deviation.
Wet density by each test method and the deviation.

3.7.3 Pervious Material

In general testing frequency specified is applicable for embankment fill and sources of material. When fill is to be placed below, adjacent, or above a pipe or structure, testing shall be completed for every other lift thickness and a minimum of every 500 feet of fill placement.

3.7.3.1 Relative Density Test

The Contractor shall complete not less than one relative density test for every 3000 cubic yards of pervious fill type in accordance with ASTM D 4253 and ASTM D 4254.

3.7.3.2 In-Place Relative Density Test

The in-place density of the pervious materials shall be determined in accordance with ASTM D 1556, ASTM D 2167, ASTM D 2922, or ASTM D 5195. The Contractor shall run not less than one (1) field in-place density test on each lift of material or every 2000 cubic yards of completed embankment fill or backfill whichever is less. Horizontal locations shall be randomly staggered in the fill. When nuclear method is used for in-place density testing according to ASTM D 2922 and ASTM D 3017, the first test and every tenth test thereafter for each material type shall include a sand cone correlation test in accordance with ASTM D 1556. The sand cone test shall be performed at the location of the nuclear test and should sample the same location that the nuclear probe and detector tested, ie as close of a distance as possible between the probe and the detector. The sand cone test shall include a nominal 6 inch diameter sand cone, and shall include a minimum wet soil weight of6 pounds extracted from the hole. The density correlations shall be submitted with test results. Each transmittal including density test data shall include a summary of all density correlations for the job prepared on a summary sheet including as a minimum:

Meter serial number and operator's initials.
Standard count for each test.
Material type.
Probe depth.
Moisture content by each test method and the deviation.
Wet density by each test method and the deviation.

3.8 CONTRACTOR QUALITY CONTROL

Contractor quality control in support of the earthwork shall include all efforts to ensure compliance with these construction documents to include support of Government efforts as part of quality assurance. The Contractor shall immediately report to the COR in writing all conditions identified in the field as a change. The Contractor efforts in support of Contractor earthwork quality control shall include but not be limited to the items indicated hereinafter.

3.8.1 Excavation

The Contractor shall complete all efforts to ensure compliance with the construction documents in support of excavation requirements for required excavation and excavation in support of non-pay items such as borrow areas.

Contractor efforts shall include but not be limited to the following:

Maintain records and complete as-built drawings and submit to the COR as required.
Complete all surveys to ensure excavations to all specified lines and grades within specified tolerances.
Complete utility location prior to excavations and documenting the utilities as required.
Use only approved equipment for work and modify as necessary and as approved by the COR.
Complete segregation of materials to include testing, stockpile, placement, removal offsite and provide for protection of segregated materials.
Complete operations to ensure protection of excavation and stockpile from run-off and discharges.
Complete operations to ensure stability of excavation and stockpiled material.

3.8.2 Fill

The Contractor shall complete all efforts to ensure compliance with the construction documents in support of fill operations' requirements for emankment, berms, pipe, and structure backfill. Contractor efforts shall include but not be limited to the following:

Maintain records, test results, and complete as-built drawings and submit to the COR as required.
Use only approved equipment for work and modify as necessary and as approved by the COR.
Complete all surveys to include survey control, grade stakes, survey sections to ensure proper project layout and that fill limits are met to include fill zones and overall fill.
Complete all proper surface preparation to receive fill.

Complete all testing of materials and fill placed to ensure compliance with the contstruction requirements.
Properly place and compact appropriate materials and protect partially and completed fill operations.

3.8.3 Miscellaneous

The Contractor shall also complete all efforts to ensure compliance with the construction documents in support of all other opertions required such as construction of the free board gages. Contractor shall perform all work in accordance with the construction documents and approved submittals. All necessary surveys shall be completed as well as maintaining all records and complete as-built drawings and submit to the COR as required.

3.8.4 Testing and Reporting

The Contractor shall complete all testing in accordance with the requirements of these construction documents. Testing specified shall be considered the minimum requirement. When there is question of the material or the fill placed or conditions occurring in the field that may impact the material or fill placed properties, the COR may require additional testing, and the Contractor shall complete the additional testing at no additional cost to the Government. As part of quality assurance, the Government may perform testing. The Contractor shall provide the samples for Government testing and when the testing is to be performed in the field, the

Contractor shall provide the testing equipment at no additional cost to the Government. The Contractor shall furnish records, test results, and related documentation to the COR in accordance with the requirements of these construction documents.

3.9 EQUIPMENT TRAFFIC ON FOUNDATION AND FILL ZONES

Equipment traffic shall be routed to distribute the compactive effort as much as practicable. Ruts formed in the a surface to receive fill material shall be filled before that material is compacted. Surfaces made smooth prior to recieving shall be scarified. Equipment traffic on pervious fill shall only be as absolutly necessary for placement and compaction.

3.10 COMPLETED AND PARTIALLY PLACED FILL

Fill placed, completly or partially, shall be shaped to drain from the fill and graded to drain away from the fill. The Contractor shall protect the fill from erosion until the specified cover is established. Erosion occurring during the interim shall be the Contractor's responsibility to repair at no additional cost to the Government. Slides or other adverse consequences caused by failure of the Contractor to comply with the requirements of this contract or, in general, failure by the Contractor to perform operations in a reasonable manner shall be considered the responsibility of the Contractor and repaired by the Contractor as approved by the COR at not additional expense to the Government.

3.11 FROZEN MATERIAL

Frozen material shall not placed in fill zones nor shall material be placed on frozen areas whether undisturbed foundation, prepared foundation, or recently placed fill. All material or zones that freeze or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to nights, holidays, weekends, or winter shutdowns of earthwork operations, shall be removed to a depth that is acceptable to the Contracting Officer and replaced with new material. Alternatively, the material shall be thawed, dried (to optimum), reworked, and recompacted to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill shall cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for the determination. Levee embankment material shall not contain frozen clumps of soil, snow or ice.

3.12 SITE EROSION CONTROL, RESTORATION, AND FINAL STATE

All surfaces disturbed by this construction shall be maintained as necessary to effectively control erosion as determined by industry standards and the COR. Disturbed surfaces not identified for a specific type of covering within this construction contract shall be restored to their preconstruction covering such as the preconstructon vegetative cover. All other surfaces shall be prepared per the requirements of these construction documents.

SECTION 02370

SOIL SURFACE EROSION CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4355	(1992) Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 792	(1998) Density and Specific Gravity (Relative Density) of Plastics by Replacement
ASTM D 4972	(1995a) pH of Soils
ASTM D 5035	(2000) Standard Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics
ASTM D 5199	(1998) Nominal Thickness of Geotextiles and Geomembranes
ASTM D 5261	(1992, R1996) Measuring Mass per Unit Area of Geotextiles
ASTM D 5268	(1996) Topsoil Used for Landscaping Purposes

EROSION CONTROL TECHNOLOGY COUNCIL (ECTC)

ECTC	(January 1997) ECTC Technical Guidance Manual (available at http://www.ectc.org)

1.2 DESCRIPTION OF WORK

The work shall consist of furnishing and installing soil surface erosion control materials, including fine grading, blanketing, stapling, mulching and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system. This section shall be coordinated with the requirements of Section, LEVEE CONSTRUCTION AND EARTHWORK and Section, SEEDING.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only. When used, a designation following the "GA" designation identifies the Kansas City District office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-04 Drawings

Layout; GA-EC
Erosion Control Details; GA-EC
Obstructions Below Ground; RE

Scale drawings defining areas to receive recommended materials, define required work, and/or identify features as required by this specification section and as required by federal, state or local regulations.

SD-01 Data

Synthetic Sheet Systems; GA-EC

Manufacturer's literature including physical characteristics, application, and installation instructions.

Equipment; RE.

A listing of equipment to be used for the application of erosion control materials.

SD-14 Samples

Materials ; GA-RE

Synthetic sheet systems; one square yard.

SD-09 Reports

Synthetic Sheet System ; GA-RE

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Tests methods used and compliance with recognized test standards shall be described.

SD-13 Certificates

Topsoil ; GA-RE

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall inclued the following:

For items listed in the section,

a. Certification of recycled content or,

b. Statement of recycled content or,

c. Certification of origin including the name, adress and telephone number of manufacturer.

Construction Work Sequence ; GA-EC

The Contractor shall prepare a plan defining the proposed sequence of erosion control system construction as described in this specification section.

Installer's Qualification ; GA-RE

The installer's company name and address; training and experience and/or certification.

SD-19 Operation and Maintenance Manuals

Maintenance Record; RE.Maintenance Instructions; RE.

Report on maintenance work performed by the Contractor prior to contract completion and instruction for year-round care of installed material. The Contractor shall include manufacturer supplied spare parts.

1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING

Materials shall be stored in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Containers shall not be dropped from trucks. Material shall be free of defects that would void required performance or warranty.

a. All synthetic sheets shall be sound and free of defects that would interfere with the proper placing of the material or impair the strength or permanence of the construction.

b. Seed shall be inspected upon arrival at the jobsite for conformity to species and quality as specified in Section, SEEDING.

1.6 SUBSTITUTIONS

Substitutions will not be allowed without written request and approval from the Contracting Officer.

1.7 INSTALLER'S QUALIFICATION

The installer shall be certified by the manufacturer for training and experience installing the material.

1.8 WARRANTY

Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.

PART 2 PRODUCTS

2.1 SYNTHETIC SHEET SYSTEM

A synthetic sheet erosion control system shall be installed by the

Contractor in areas as shown on the drawings. The synthetic sheet system shall consist of Composite Reinforcement Mat Series P550 as manufactured by the North American Green Corporation, or the equivalent as approved by the Contracting Officer. The composite reinforcement mat shall be a machine produced matting of 100% UV stabilized polypropylene fiber matrix incorporated into a permanent three-dimensional netting structure.

The mnatrix shall be evenly distributed across the entire width of the matting and stitch bonded between three heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle, cuspated (crimped) netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50-inch (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent three-dimensional structure.

All mats shall be manufactured with a colored thread stitched along both outer edges, approximately 2-5 inches (5-12.5 cm) from the edge, as an overlap guide for adjacent mats.

The permanent composite reinforcement mat shall possess the following physical properties:

Material Content

Matrix 100% UV Stabilized Polypropylene Fibers (0.60 lbs/yd2)

Netting Top and Bottom Layers - Heavy Duty UV Stabilized Polypropylene (24 lb/1,000 ft2 approximate weight)

Mid-Layer Net - Heavy Duty UV Stabilized Polypropylene (24 lb/1,000 ft2 approximate weight)

Thread Black UV Stabilized Polypropylene

Mechanical Properties

	English	Metric
Thickness (ASTM D 5199)	0.76 inches	19.30 mm
Density (ASTM D 792)	0.528 oz/in3	0.913 g/cm3
Porosity (ECTC Guidelines)	96%	96%
Light Penetration (ECTC Guidelines)	16%	16%
MD Tensile Strength (ASTM D 5035)	1300 lbs/ft	21.84 kN/m
TD Tensile Strength (ASTM D 5035)	1500 lbs/ft	21.84 kN/m
MD Elongation (ASTM D 5035)	13%	13%
TD Elongation (ASTM D 5035)	13%	13%
Mass/Unit Area (ASTM D 5261)	20.28 oz/yd2	687 g/m2
UV Stability (ASTM D 4355)	90%	90%

MD - Machine Direction
TD - Transverse Direction

Physical Specifications

Physical specifications of the permanent composite reinforcement is provided on a per roll basis.

	English	Metric

Width	6.50 feet	2.00 m
Length	55.50 feet	16.90 m
Weight	52.00 lbs ± 10%	23.58 kg ± 10%
Area	40.00 yds2	33.40 m2
Stitch Spacing	1.50 inch	3.81 cm

2.2 WATER

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall be potable or supplied by an existing irrigation system.

PART 3 EXECUTION

3.1 CONDITIONS

The Contractor shall submit a construction work sequence schedule, with the approved erosion control plan a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures. Erosion control operations shall be performed under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, a revised construction schedule shall be submitted for approval. Erosion control materials shall not be applied in adverse weather conditions which could affect their performance.

3.1.1 Finished Grade

The Contractor shall verify that finished grades are as indicated on the drawings; finish grading and compaction shall be completed in accordance with Section, LEVEE CONSTRUCTION AND EARTHWORK, prior to the commencement of the work. The location of underground utilities and facilities in the area of the work shall be verified and marked. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.2 SITE PREPARATION

3.2.1 Soil Test

Soil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.

3.2.2 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop drawing shall be submitted indicating the corrective measures.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded along the dripline. Damage to existing trees shall be mitigated by the Contractor at no additional cost to the Government. Damage shall be

assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

3.2.4 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to placement of erosion control material shall be submitted for approval.

3.3 INSTALLATION

3.3.1 Seeding

When seeding is required prior to installing mulch on synthetic grid systems the Contractor shall verify that seeding will be completed in accordance with Sections, LEVEE CONSTRUCTION AND EARTHWORK and SEEDING.

3.3.2 Synthetic Sheet System

Synthetic sheet systems shall be anchored in accordance with the manufacturer's recommendations.

3.3.3 Sheet System Seeding

Seed shall be installed in accordance with Section 02921 SEEDING and according to composite reinforcement mat manufacturer's recommendations.

3.4 CLEAN-UP

Excess material, debris, and waste materials shall be disposed offsite at an approved landfill or recycling center. Adjacent paved areas shall be cleared.

3.5 WATERING SEED

Watering shall be started immediately after installing erosion control material. Water shall be applied to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.6 MAINTENANCE RECORD

A record shall be furnished describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.6.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

3.6.1.1 Maintenance Instructions

Written instructions containing drawings and other necessary information shall be furnished, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for

material replacement.

3.6.1.2 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Material not meeting the required performance as a result of placement, seaming or patching shall be removed from the site. The Contractor shall replace the unacceptable material at no additional cost to the Government.

3.7 SATISFACTORY STAND OF GRASS PLANTS

When erosion control material is installed, the grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high. A satisfactory stand of grass shall be as defined in Section, SEEDING. The total bare spots shall not exceed the limitations of Section, SEEDING.

-- End of Document --

SECTION 02371

WIRE MESH GABIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 90/A 90M	(1995a) Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A 185	(1990a) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 239	(1989) Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
ASTM A 313/A 313M	(1995a) Stainless Steel Spring Wire
ASTM A 428/A 428M	(1995) Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles
ASTM A 641/A 641M	(1997) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 764	(1990) Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Springs
ASTM A 809	(1995) Aluminum Coated (Aluminized) Carbon Steel Wire
ASTM A 818	(1991; R 1996) Coppered Carbon Steel Wire
ASTM A 853	(1993) Steel Wire, Carbon, for General Use
ASTM A 975	(1997) Double Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Polyvinyl Chloride (PVC) Coating)
ASTM B 6	(1987) Zinc
ASTM B 117	(1990) Salt Spray (Fog) Testing
ASTM D 412	(1987) Rubber Properties in Tension

ASTM D 638	(1990) Test Method for Tensile Properties of Plastics
ASTM D 638M	(1997) Test Method for Tensile Properties of Plastics (Metric)
ASTM D 746	(1979; R 1987) Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 792	(1986) Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1242	(1987) Resistance of Plastic Materials to Abrasion
ASTM D 1499	(1984; R 1990) Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
ASTM D 2240	(1986) Rubber Property - Durometer Hardness
ASTM D 2287	(1981; R 1988) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM G 23	(1990) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

1.2 GENERAL REQUIREMENTS

The work under this specification includes furnishing, assembling, filling, and tying open wire mesh rectangular compartmented gabions placed on a prepared surface of geotextile as specified herein, and in accordance with the lines, grades, and dimensions shown on the drawings or otherwise established in the field by the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a GA designation; submittals having an FIO designation are for information only. When used, a designation following the GA designation identifies the Kansas City District office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-13 Certificates

Gabions; GA-GL. Alternative Wire Fasteners for Gabions; GA-GL.

For each shipment of wire materials to the site, the Contractor shall furnish the Contracting Officer, in duplicate, a manufacturer's certificate or affidavit signed by a legally authorized official from the company manufacturing the gabion units and wire fasteners, that all material

contained within that shipment meets the composition, physical, and manufacturing requirements stated in this specification.

Pier Protection Plan; GA-GL.

If any bridge piers are encountered during placement of the gabion units, the Contractor shall develop a Pier Protection Plan discussing means to be implemented to ensure protection of the piers from damage during construction. The plan shall be submitted to the Contracting Officer for approval. Work shall not proceed until approval has been obtained.

SD-14 Samples

Stone Fill; GA-RE.

Samples of gabion basket stone fill material submitted for approval prior to delivery of production quantities to the site.

1.4 DESCRIPTION

Gabion units shall consist of compartmented rectangular basket containers filled with stone. Gabions shall be supplied, as specified, in various lengths and heights. The lengths shall be multiples (2, 3, or 4) of the horizontal width. However, all gabions furnished by a manufacturer shall be of uniform width. Dimensions for heights, lengths and widths are subject to a tolerance limit of 3% of manufacturer's stated sizes. Twisted wire mesh shall be used. Baskets shall be fabricated from galvanized steel wire formed into a nonraveling mesh.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Gabions

Wire mesh gabions shall be galvanized .

2.1.1.1 Steel Twisted Wire Mesh Gabions

Gabion basket units shall be of nonraveling construction and fabricated from a double twisted hexagonal wire mesh in accordance with ASTM A 975. The size of mesh openings shall be approximately 3-1/4 inches by 4-1/2 inches. The gabion mesh wires shall be wrapped around the selvage wire no less than 1-1/2 times and shall interconnect with adjacent mesh wires. All steel wire used shall be galvanized prior to fabrication into mesh. All gabion diaphragm and frame wire shall equal or exceed ASTM A 641/A 641M, ASTM A 809, ASTM A 818, and ASTM A 853, and possess soft tensile strength of 60,000 pounds per square inch (psi) with a tolerance of minus 2,000 psi. The galvanized wire shall have a Finish 5, Class 3, zinc coating, as indicated in ASTM A 641/A 641M. The weight of coating shall be determined by ASTM A 90/A 90M. The grade of zinc used for coating shall be High Grade or Special High Grade as prescribed in ASTM B 6, Table 1. The uniformity of coating shall equal or exceed four 1-minute dips by the Preece Test, as

determined by ASTM A 239. Wire used for lacing or as internal connecting wire within basket cells may have soft tensile strength designation. As an alternative to lacing, wire fasteners may be used. All wire used shall meet the following nominal minimum requirements:

GALVANIZED WIRE

TYPE OF WIRE	WIRE DIAMETER AFTER COATING (inches)	COATING WEIGHT (oz/sq ft)	TENSILE STRENGTH (psi)
Mesh Wire	0.120	0.85	60,000
Selvage Wire	0.150	0.85	60,000
Lacing Wire or Internal Connecting Wire	0.087	0.70	60,000

Gabion mesh and connections require the following minimum strength:

STRENGTH	POUNDS PER LINEAR FOOT
Wire mesh strength (pulled parallel to wire twists)	2,000
Wire mesh strength (pulled perpendicular to wire twists)	1,000
Connection of selvage wire to mesh	1,400
Connection of end panel to base	1,200
Connection of diaphragm	600

2.1.2 Alternative Wire Fasteners for Gabions

2.1.2.1 General

Subject to approval of the Contracting Officer, wire fasteners including interlocking fasteners, ring fasteners, twist ties, and spiral binders may be used in lieu of lacing wire. When seeking such approval, the Contractor shall demonstrate to the satisfaction of the Contracting Officer:

a. That the proposed fastener system can consistently produce a joint with a strength of 1,400 pounds per lineal foot when tested in accordance with paragraph PULL-APART RESISTANCE TEST;

b. That the proposed fastener system does not cause damage to the protective coating on the wire;

c. That the Contractor has the proper equipment and trained employees to correctly install the fasteners; and

d. That proper installation can be readily verified by visual inspection.

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required, the number and size of wires that fastener is capable of properly joining, and a description of a properly installed fastener, including drawings or photographs if necessary. A properly installed fastener shall meet the same requirements as that specified for the fasteners in the paragraph SALT SPRAY TEST. If gages or other aids are needed to verify the proper installation of the fasteners, the Contractor shall furnish the Government such gages or aids, in such number as may reasonably be required, for the use of Government inspectors. If more than one wire fastener is proposed (e.g. different gage or length of wire) for different joints, the fasteners shall be readily distinguishable. Alternate wire fasteners shall not be used to join more wires, or larger wires, than for which they were tested and approved. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvage or edge wire. Alternate wire fasteners shall not be used to close basket lids unless specifically approved for that purpose. When seeking approval to use alternate wire fasteners to close basket lids, the Contractor shall demonstrate to the satisfaction of the Contracting Officer that the fasteners can be properly installed on a properly filled gabion without stretching the gabion to the point that the gabion, or the protective wire coating, is damaged.

2.1.2.2 Wire Fasteners Materials

Galvanized wire fasteners shall be used with galvanized gabions. Twist tie or spiral binder fasteners shall meet the requirements of lacing wires as specified in paragraph STEEL TWISTED WIRE MESH GABIONS

2.1.2.3 Tests

Test records made within 5 years by certified laboratories and Government agencies will be used to determine the acceptability of wire fasteners. Samples of wire fasteners with their certified test records shall be submitted at least 60 days in advance to the Contracting Officer for approval. The Government reserves the right to test additional samples to verify the submitted test records at the Government's expense. When the first test results indicate that the fasteners do not meet the specified requirements, the additional test will be at the Contractor's expense. The fasteners will be rejected after two tests failing to meet the requirements. All types of fasteners including fasteners made of stainless steel shall be subject to the salt spray test and pull-apart resistance test.

a. Salt Spray Test - A set of two identical rectangular gabion panels, each with a width about 10-1/2 mesh openings along a selvage wire, shall be jointed by properly installed wire fasteners along the two selvage wires so that each fastener confines two selvage and two mesh

wires. If the fasteners are also to be used to joint two individual empty gabion baskets, two additional selvage wires which are each mechanically wrapped with mesh wires shall be included so that each fastener confines four selvage and four mesh wires. The set of the jointed panels shall be subject to salt spray test, ASTM B 117, for a period of not less than 48 hours. At the end of the test, the fasteners, the selvage, or mesh wires confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends. A properly installed fastener shall meet the following requirements:

(1) Each interlocking fastener shall be in a locked and closed position.

(2) Each ring fastener shall be closed, and the free ends of the fastener shall overlap a minimum of 1 inch.

(3) Each twist tie shall be closed and maintain a minimum of two full turns.

(4) The spiral binder shall be tied at both ends.

b. Pull-Apart Resistance Test - A new set of the jointed panels, which are prepared by the same method as specified in the salt spray test but without being subject to the 48-hour salt spray test, shall be mounted on a loading machine with grips or clamps such that the panels are uniformly secured along the full width. The grips or clamps shall be designed to transmit only tension forces. The load will then be applied at a uniform rate of 50 pounds per second until failure occurs. The failure is defined as when the maximum load is reached and a drop of strength is observed with subsequent loading or the opening between any two closest selvage wires, applicable to a fastener confining either two or four selvage wires, becomes greater than 2 inches at any place along the panel width. The strength of the jointed panels at failure shall have a minimum of 1,400 pounds per linear foot.

2.1.3 Stone Fill

2.1.3.1 Quality

Stone shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used. It shall be free of cracks, seams, and other defects that would tend to increase unduly its deterioration from natural causes or reduce its size to that which could not be retained in the gabion baskets. The inclusion of more than 5% by weight of dirt, sand, clay, and rock fines will not be permitted. Stone shall be produced from an approved source in accordance with Section, GENERAL, and shall not contain more than 5 percent of earth, sand, shale, and non-durable rock.The sources from which the Contractor proposes to obtain the material shall be selected well in advance of the time when the material will be required in the work. Suitable samples of stone fill material shall be collected in the presence of a Government representative and submitted to the Contracting Officer for approval prior to delivery of any such material to the site of the work.

2.1.3.2 Gradation

Stone fill used in the gabions shall be a well-graded mixture with sizes ranging between 4 inches and 8 inches, based on US Standard square mesh sieves or with the following alternate gradation. No stone shall have a minimum dimension less than 4 inches and a maximum dimension greater than 12 inches in any direction. The ratio of the maximum dimension to the minimum dimension shall not be greater than two. If the height of the gabion basket is 12 inches or less, stone shall have no dimensions greater than 8 inches in any direction.

Alternate stone Gradation

Percent Lighter by Weight	Weight per Stone
100%	100 lbs
50%	50 lbs
15%	25 lbs
5%	Less than 3 Lbs

2.1.4 Filter Fabric

The filter fabric shall consist of Mirafi 180N or equivalent as approved by the COR. Filter fabrics shall meet the provisions of Section, GEOTEXTILES USED AS FILTERS

PART 3 EXECUTION

3.1 FOUNDATION PREPARATION

No foundation preparation work shall take place on frozen or snow-covered ground. After excavation or stripping to the extent indicated on the drawings or as directed by the Contracting Officer, all remaining loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free-draining materials. Otherwise, the depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. Any buried debris protruding from the foundation that will impede the proper installation and final appearance of the gabion layer shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to placing the material, the prepared foundation surface shall be inspected by the Contracting Officer, and no material shall be placed thereon until that area has been approved.

3.2 FABRICATION

3.2.1 Galvanized Steel Wire Mesh Gabions

Gabions shall be fabricated in such a manner that the sides, ends, lid, and

diaphragms can be assembled at the construction site into rectangular baskets of the specified size. Gabions shall be of single unit construction, i.e., the base, lid, ends, and sides shall be either woven into a single unit, or one edge of these members connected to the base section of the gabion in such a manner that the minimum strengths of the wire mesh and connections as stated in paragraph MATERIALS are met. Where the length of the gabion exceeds one and one-half its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gage as the body of the gabions, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. For twisted wire gabions, all perimeter edges of the mesh forming the gabion shall be securely selvaged so that the joints formed by tying the selvages have at least the strengths as specified in paragraph MATERIALS. In addition, the selvaged edges shall be so wrapped and reinforced with the mesh ends that the selvage wire will not be deformed locally about the lacing wire or wire fasteners when baskets are filled or during lid closing. Lacing wire, connecting wire, and/or wire fasteners shall be supplied in sufficient quantity for securely fastening all diaphragms and edges of the gabion.

3.3 ASSEMBLY AND INSTALLATION

3.3.1 Gabion Units

Empty gabion units shall be assembled individually and placed on the approved surface to the lines and grades as shown on the drawings or as directed by the Contracting Officer, with the sides, ends, and diaphragms erected in such a manner to ensure the correct position of all creases and that the tops of all sides are level. Filling of gabion units in one place and then transporting them to their final position in the work will not be permitted. The front row of gabion units shall be placed first and successively constructed toward the top of the slope or the back of the structure. All gabion units shall be properly staggered horizontally as shown on the drawings. Finished gabion structure shall have no gaps along the perimeter of the contact surfaces between adjoining gabion basket units. All adjoining empty gabion units shall be connected by lacing wire/or wire fasteners along the perimeter of their contact surfaces in order to obtain a monolithic structure. Lacing of adjoining basket units shall be accomplished by continuous stitching with alternating single and double loops at intervals of not more than 5 inches, and a half hitch shall be included at every double loop. All lacing wire terminals shall be securely fastened. Wire fasteners may be used in lieu of lacing wire for forming individual baskets and joining empty baskets together prior to stone filling. All joining shall be made through selvage-to-selvage or selvage-to-edge wire connection; mesh-to-mesh or selvage-to-mesh wire connection is prohibited except in the case where baskets are offset or stacked and selvage-to-mesh or mesh-to-mesh wire connection would be necessary. Wire fasteners shall not be used to tie or join stone-filled baskets, unless approved by the Contracting Officer. Each wire fastener shall be properly installed and closed as specified in paragraph ALTERNATIVE WIRE FASTENERS FOR GABIONS, subparagraph TESTING, subparagraph SALT SPRAY TEST. As a minimum, a fastener shall be installed at each mesh opening at the location where mesh wire meets selvage or edge wire. The

initial line of basket units shall be placed on the prepared filter layer surface and partially filled to provide anchorage against deformation and displacement during filling operations. After adjoining empty basket units are set to line and grade and common sides with adjacent units thoroughly laced or fastened, they shall be placed in tension and stretched to remove any kinks from the mesh and to a uniform alignment. The stretching of empty basket units shall be accomplished in such a manner as to prevent any possible unraveling. Stone filling operations shall carefully proceed with placement by hand or machine so as not to damage galvanized wire coating, to assure a minimum of voids between the stones, and the maintenance of alignment throughout the filling process. Undue deformation and bulging of the mesh shall be corrected prior to further stone filling. To avoid localized deformation, the basket units in any row are to be filled in stages consisting of maximum 12-inch courses, and at no time shall any cell be filled to a depth exceeding 1 foot more than the adjoining cell. The maximum height from which the stone may be dropped into the basket units shall be 36 inches. For gabion units in excess of 2 feet in height, two uniformly spaced internal connecting wires shall be placed between each stone layer in all front and side gabion units, connecting the back and the front faces of the compartments. Connecting wires or alternatively the preformed stiffeners shall be looped around two twisted wire mesh openings or a welded wire joint at each basket face and the wire terminals shall be securely twisted to prevent their loosening. For twisted wire gabions, the internal connecting wires or preformed stiffeners are installed as shown on the drawings. Along all exposed faces, the outer layer of stone shall be carefully placed and arranged by hand to ensure a neat and compact appearance. The last layer of stone shall be uniformly overfilled 1 to 2 inches to compensate for the future settlement in rock but still allow for the proper closing of the lid and to provide an even surface that is uniform in appearance. Final adjustments for compaction and surface tolerance shall be done by hand. Lids shall be stretched tight over the stone fill using only an approved lid closing tool, until the lid meets the perimeter edges of the front and end panels. Using crowbars or other single point leverage bars for lid closing shall be prohibited. The lid shall then be tightly tied with lacing wire, or with wire fasteners if approved by the Contracting Officer, along all edges, ends, and internal cell diaphragms by continuous stitching with alternating single and double loops at intervals of not more than 5 inches, and a half hitch shall be included at every double loop. Special attention shall be given to see that all projections or wire ends are turned into the baskets. The Contractor shall have the option of providing gabion baskets with separate roll-out lids for the foot by foot slope baskets. Roll-out lids shall be fabricated of the same material as the basket units and shall be furnished in the width as required for the contract work. Where shown on the drawings or as directed by the Contracting Officer, or where a complete gabion unit cannot be installed because of space limitations, the basket unit shall be cut, folded, and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh cut out completely, or folded back and neatly wired to an adjacent gabion face. The assembling, installation, filling, lid closing, and lacing of the reshaped gabion units shall be carried out as specified above.

SECTION 02378

GEOTEXTILES USED AS FILTERS
05/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 123	(1993a) Standard Terminology Relating to Textiles
ASTM D 1683	(1990a) Failure in Sewn Seams of Woven Fabrics
ASTM D 3786	(1987) Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 3884	(1992) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4354	(1989) Sampling of Geosynthetic for Testing
ASTM D 4355	(1992) Deterioration of Geotextile from Exposure to Ultraviolet light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1992) Water Permeability of Geotextiles By Permittivity
ASTM D 4533	(1991) Trapezoid Tearing Strength of Geotextile
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1993) Determining the Apparent Opening Size of a Geotextile
ASTM D 4833	(1988) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(1988) Guide for Identification, Storage, and Handling of Geotextiles
ASTM D 4884	(1990) Seam Strength of Sewn Geotextiles

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-13 Certificates

Geotextile; FIO-RE.

The Contractor shall submit a certification of the geotextile material from the manufacturer.

SD-14 Samples

Geotextile; FIO-RE.

If requested by the Contracting Officer, the Contractor shall provide to the Government geotextile samples for testing to determine compliance with any or all of the requirements in this specification. When samples are to be provided, they shall be submitted a minimum of 30 days prior to the beginning of installation of the same textile. A written certificate of compliance signed by a legally authorized official from the company shall be submitted, in duplicate, upon delivery of the geotextile. The certificate shall state that the geotextile shipped to the site meets the chemical requirements and exceeds the minimum average roll value listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Upon request, the contractor shall supply quality control and quality assurance tests for the geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation. For needle punched geotextile, the manufacturer shall certify that the geotextile has been inspected using permanent on-line metal detectors and does not contain any needles.

1.3 SHIPMENT, HANDLING, AND STORAGE

1.3.1 Shipment and Storage

Only approved geotextile rolls, , shall be delivered to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873. No hooks, tongs, or other sharp instruments shall be used for handling geotextile.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Geotextile

2.1.1.1 General

The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall equal or exceed the minimum average roll values listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Strength values indicated in the table are for the weaker principal direction.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAP STRENGTH	lb	200	ASTM D 4632
ELONGATION	%	50	ASTM D 4632
PUNCTURE STRENGTH	lb	90	ASTM D 3787
BURST STRENGTH	psi	190	ASTM D 3786
TRAPEZOID TEAR	lb	40	ASTM D 4533
PERMEABILITY	cm/sec	0.1	ASTM D 4491
APPARENT OPENING SIZE	U.S. SIEVE	70	ASTM D 4751
PERMITTIVITY	sec -1	0.1	ASTM D 4491
ULTRAVIOLET DEGRADATION	Percent	50 AT 500 Hrs	50 AT 500 Hrs ASTM D 4355

2.1.1.2 Geotextile Fiber

Fibers used in the manufacturing of the geotextile shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

2.1.2 Seams

The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary., to form sections not less than 10 feet wide. Seams shall be tested in accordance with method ASTM D 1683. The strength of the seam shall be not less than 90 percent of the required grab tensile strength of the unaged geotextile in any principal direction.

2.1.3 Securing Pins

The geotextile shall be secured to the embankment or foundation soil by pins to prevent movement prior to placement of revetment materials. Other

appropriate means to prevent movement such as staples, sand bags, and stone could also be used. Securing pins shall be inserted through both strips of overlapped geotextile along the line passing through midpoints of the overlap. Securing pins shall be removed as placement of revetment materials are placed to prevent tearing of geotextile or enlarging holes maximum spacing between securing pins depends on the steepness of the embankment slope. The maximum pins spacing shall be equal to or less than the values listed in TABLE 2, MAXIMUM SPACING FOR SECURING PINS. When windy conditions prevail at the construction site, the number of pins should be increased upon the demand of the Contracting Officer. Terminal ends of the geotextile shall be anchored with key trench or apron at crest, toe of the slope and upstream and downstream limits of installation.

TABLE 2
MAXIMUM SPACING FOR SECURING PINS

EMBANKMENT	SPACING, feet
STEEPER THAN 1V ON 3H	2
1V ON 3H TO 1V ON 4H	3
FLATTER THAN 1V ON 4H	5

2.2 INSPECTIONS, VERIFICATIONS, AND TESTING

2.2.1 Manufacturing and Sampling

Geotextiles and factory seams shall meet the requirements specified in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Conformance testing shall be performed in accordance with the manufacturers approved quality control manual.

2.2.2 Site Verification and Testing

Samples shall be collected at approved locations upon delivery to the site at the request of the Contracting Officer . Samples shall be tested to verify that the geotextile meets the requirements specified in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. Samples shall be identified by manufacturers name, type of geotextile, lot number, roll number, and machine direction. Testing shall be performed at an approved laboratory. Test results from the lot under review shall be submitted and approved prior to deployment of that lot of geotextile. Rolls which are sampled shall be immediately rewrapped in their protective covering.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surface on which the geotextile will be placed shall be prepared, to a relatively smooth surface condition, in accordance with the applicable portion of this specification and shall be free from obstruction, debris, depressions, erosion feature, or vegetation. Any irregularities will be removed so as to insure continuous, intimate contact of the geotextile with

all the surface. Any loose material, soft or low density pockets of material, will be removed; erosion features such as rills, gullies etc. must be graded out of the surface before geotextile placement.

3.2 INSTALLATION OF THE GEOTEXTILE

3.2.1 General

The geotextile shall be placed in the manner and at the locations shown. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

3.2.2 Placement

The geotextile shall be placed with the long dimension perpendicular to the centerline of the levee and laid smooth and free of tension, stress, folds, wrinkles, or creases. Single, continuous fabric strips shall extend unbroken and unseamed from the levee crest to the levee toe. The Contractor shall adjust the actual length of the geotextile used based on initial installation experience. Temporary pinning of the geotextile to help hold it in place until the riprap is placed shall be allowed. The temporary pins shall be removed as the riprap is placed to relieve high tensile stress which may occur during placement of material on the geotextile. Design protection of riprap should be in compliance with EM 1110-2-1601. Trimming shall be performed in such a manner that the geotextile shall not be damaged in any way.

3.3 PROTECTION

The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of riprap shall be replaced by the Contractor at no cost to the Government. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of riprap or other materials. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary. Care should be taken to ensure that the utilized cushioning materials shall not impede the flow of water. Before placement of riprap or other materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

3.4 PLACEMENT OF CUSHIONING MATERIAL

Placing of cushioning material shall be performed in a manner to insure intimate contact of the geotextile with the prepared surface and with the cushioning material. The placement shall also be performed in a manner that shall not damage the geotextile including tear, puncture, or abrasion. On sloping surfaces the cushioning material shall be placed from the bottom of the slopes upward. During placement, the height of the drop of riprap material shall not be greater than 12 inches. Any geotextile damaged beneath the cushioning material shall be uncovered as necessary and

replaced at no cost to the Government.

3.5 OVERLAPPING AND SEAMING

3.5.1 Overlapping

Adjacent fabric strips extending form the levee crest to the levee toe shall overlap each other a minimum of 12 inches, with the upstream sheet lying on the top of the downstream sheet. Appropriate measures will be taken to insure required overlap exists after cushion placement.

3.5.2 Sewn Seams

High strength thread should be used such that seam test should conform to ASTM D 1683. The thread shall meet the chemical, ultraviolet, and physical requirements of the geotextile, and the color shall be different from that of the geotextile. The seam strength shall be equal to the strength required for the fabric in the direction across the seam. Overlapping J-type seams are preferable over prayer-type seams as the overlapping fabric reduces the chance of openings to occur at the seam. Double sewing shall be used specially for field seams to provide a safety factor against undetected missed stitches.

-- End of Section --

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SECTION 02380

STONE PROTECTION
04/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 4791	(1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

1.2 TESTING

1.2.1 Stone

1.2.1.1 General

All stone shall be durable material as approved by the Contracting Officer. Stone shall be of a suitable quality to ensure permanence in the structure and in the climate in which it is to be used. It shall be free from cracks, blast fractures, bedding, seams and other defects that would tend to increase its deterioration from natural causes. Inspections for cracks, fractures, seams and defects shall be made by visual examination. If, by visual examination, it is determined that 10 percent or more of the stone produced contains hairline cracks, then all stone produced by the means and measures which caused the fractures shall be rejected. A hairline crack that is defined as being detrimental shall have a minimum width of 4 mil and shall be continuous for one-third the dimension of at least two sides of the stone. The stone shall be clean and adequately free from all foreign matter. Any foreign material adhering to or combined with the stone as a result of stockpiling shall be removed prior to placement.

1.2.1.2 Sources

Stone shall be furnished from any of the sources listed in Section, GENERAL.

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Riprap; GA-EC. Bedding Material; GA-EC.

Submit the source for materials used in riprap and bedding.

SD-09 Reports

Gradation Test; GA-RE.

Submit the gradation tests using the GRADATION TEST DATA SHEET enclosed at end of this section for stone.

SD-13 Certificates

Stone; FIO. Bedding Material; FIO.

Submit certificates of compliance attesting that the materials meet specification requirements.

Laboratory; GA-RE.

Submit a copy of the documents, provided by the Materials Testing Center (MTC) at CEWES or other governmental agency, that validates that the laboratory can perform the required tests. The individual tests shall be listed for which the validation covers along with the date of the inspection.

Weigh Scale Certification; FIO-RE.

Submit a copy of the certification from the regulation agency attesting to the scale's accuracy.

Certified Weight Scale Tickets; FIO-RE.

Submit a copy of each certified weight scale ticket 5 working day(s) after weighing.

1.4 CONSTRUCTION TOLERANCES

The finished surface and stone layer thickness shall not deviate from the lines and grades shown by more than the tolerances listed below. Tolerances are measured perpendicular to the indicated neat lines. Extreme

limits of the tolerances given shall not be continuous in any direction for more than the nominal stone dimension nor for an area greater than 100 square feet of the structure surface.

NEATLINE TOLERANCES

MATERIAL	ABOVE NEATLINE inches	BELOW NEATLINE inches
Bedding	1	1
Riprap	5	2

The intention is that the work shall be built generally to the required elevations, slope and grade and that the outer surfaces shall be even and present a neat appearance. Placed material not meeting these limits shall be removed or reworked as directed by the Contracting Officer. Payment will not be made for excess material which the Contracting Officer permits to remain in place.

Pounding or pressing stones with a backhoe, bucket or similar equipment during stone placement in order to meet the required construction tolerances is prohibited.

PART 2 PRODUCTS

2.1 BEDDING MATERIAL

2.1.1 General

Bedding material shall consist of a washed gravel or crushed stone.

2.1.2 Material

Bedding material shall be composed of tough, durable particles, adequately free from thin, flat and elongated pieces, and shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Contracting Officer. The aggregates shall meet the quality requirements of ASTM C 33. Gradation shall conform to the following requirements:

U.S. STANDARD SIEVE	PERMISSIBLE LIMITS PERCENT BY WEIGHT, PASSING
BEDDING	
6 in.	100
3 in.	75-95
1 in.	40-60
1/4 in.	5-25

The bedding material shall be well-graded between the limits shown. At least one test shall be performed on each 1000 tons placed for each specified gradation in accordance with ASTM C 136. All points on individual grading curves obtained from representative samples of bedding material shall lie between the boundary limits as defined by smooth curves drawn through the tabulated gradation limits plotted on ENG FORM 2087, attached at the end of this section. The individual gradation curves within these limits shall not exhibit abrupt changes in slope denoting either gap grading or scalping of certain sizes or other irregularities which would be detrimental to the proper functioning of the bedding layers.

2.2 STONE

2.2.1 General

2.2.1.1 Gradation Test

The Contractor shall perform at the quarry gradation testing on the stone. The sample shall be taken by the Contractor from the truck in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer not less than 3 days in advance of each test. In the event of unavailability of the Contracting Office, the Contractor shall perform the tests and certify to the Contracting Officer that the stone complies with the specifications. One gradation test(s) shall be performed on 42-inch riprap and two tests for 18-inch riprap designated for use at Line Creek sites and one test shall be performed on riprap designated for use at Quintero Levee sites. Each sample shall consist of not less than 10 tons of stone and shall be collected in a random manner to provide a sample which accurately reflects the actual gradation arriving at the jobsite. Failure of the test on the initial sample and on an additional sample will be considered cause for rejection of the quarry and/or quarry process, and all stone represented by the failed test samples shall be set aside and not incorporated into the work. Any additional tests required because of the failure of an initial test sample will not be considered as one of the other required tests. Each truckload shall be representative of the gradation requirements. If the gradation test fails, additional gradation tests will be required at the Contractor's expense to delineate the limits of unacceptable stone within the quarry face(s). The additional gradation tests shall not count as part of the minimum number of gradation tests required. The unacceptable stone shall either be reworked to bring the stone within the specified gradation or the stone shall not be shipped to or shall be removed from the project site as appropriate and as determined by the Contracting Officer. The Contracting Officer may direct this testing under the Contract Clause INSPECTION OF CONSTRUCTION. The Contractor shall provide all necessary screens, scales and other equipment, and operating personnel, and shall grade the sample. Certification and test results shall represent riprap, stone, and related material shipped from the quarry. Certification and tests results must be received by the Contracting Officer at the jobsite before the stone is used in the work.

2.2.1.2 Proportional Dimension Limitations

A maximum of 3 percent flat and elongated pieces by weight will be acceptable. A flat and elongated piece of riprap is defined as having a ratio of width to thickness or length to width greater than 3:1. ASTM D 4791 shall be used as a guide to perform the test.

2.2.1.3 Stockpile

Storage of stone at the worksite is not to be confused with off-site stockpiling of stone. If the Contractor elects to provide off-site stockpiling areas, the Contracting Officer shall be notified by the Contractor of all such areas. The first layer shall be a maximum of 6 feet high. After being stockpiled, stone which has become contaminated with soil or refuse shall not be put into the work unless the contaminating material has been removed from the stone prior to placement.

a. Worksite Stockpile

Temporary storage of stone at the worksite will be allowed, provided the stockpile toe of the stone be no closer than 100 linear feet from the closest edge of the top slope, and the amount shall not exceed 200 T.

b. Off-site Stockpile

In areas where stone is stockpiled for placement, the area shall have excess rock removed prior to completion of work. All rock greater than 3 inches in diameter shall be removed. Where rocks may have become buried due to soft ground or operation of the equipment, the rock shall be put in a disposal area. After the rock has been removed, the storage area shall be graded, dressed, and filled to return the ground surface as near as practical to the condition that existed prior to construction.

2.2.2 Spalls

Stone for spalls shall be composed of tough, durable particles. The total of objectionable material, soft, friable particles, and other foreign matter shall not exceed 5 percent by weight. Material retained on the 4-inch sieve shall be reasonably free from flat particles.

SPALLS

BY WEIGHT Passing	SIEVE SIZE
100	10"
70-95	7"
40-60	5"
20-40	3"
0-20	2"

2.2.3 Riprap

Only quarried stone shall be used. Stone shall be well graded and shall conform to the table below

18-INCH RIPRAP

(Minimum Layer Thickness))

PERCENT LIGHTER BY WEIGHT (SSD)	LIMITS OF STONE WEIGHT, LB.
100	300
85-95	200
30-50	75
0-15	10

24-INCH RIPRAP

(Minimum Layer Thickness))

PERCENT LIGHTER BY WEIGHT (SSD)	LIMITS OF STONE WEIGHT, LB.
100	700
85-95	525
30-50	175
0-15	30

42-INCH RIPRAP

(Minimum Layer Thickness))

PERCENT LIGHTER BY WEIGHT (SSD)	LIMITS OF STONE WEIGHT, LB.
100	4,000
80-95	3,000
30-50	1,000
0-20	200

PART 3 EXECUTION

3.1 BASE PREPARATION

Areas on which bedding material and riprap are to be placed shall be graded and/or dressed to conform to cross sections shown on the contract drawings within an allowable tolerance of plus 1 inch and minus 2 inches from the theoretical lines and grades. The prepared base shall be approved by the Contracting Officer. Where such areas are below the allowable minus tolerance limit they shall be brought to grade by fill with earth similar

to the adjacent material and then compacted to a density equal to the adjacent in place material. Immediately prior to placing the bedding layers, the prepared base will be inspected by the Contracting Officer, and no material shall be placed thereon until that area has been approved.

3.2 PLACEMENT OF BEDDING

Bedding shall be spread uniformly on the prepared base to the slope lines, grades, and thickness indicated on the drawings. Placing of material by methods which tend to segregate particle sizes will not be permitted. Any damage to the underlying surface during placement shall be repaired before proceeding with the work. Compaction of the layer will not be required, but it shall be finished to a reasonably smooth surface.

3.3 PLACEMENT OF RIPRAP

3.3.1 General

Riprap shall be placed within the limits shown on the contract drawings.

3.3.2 Placement

Riprap shall be placed in a manner which will produce a well-graded mass of rock with the minimum practicable percentage of voids, and shall be constructed, within the specified tolerances, to the lines and grades shown on the contract drawings or staked in the field. A tolerance of plus 5 inches and minus 2 inches from the slope lines and grades shown on the contract drawings will be allowed in the finished surface of the riprap, except that the extreme of this tolerance shall not be continuous over an area greater than 200 square feet. The average tolerance of the entire job shall have no more than 50 percent of the tolerances specified above. Riprap shall be placed by means of truck, crane operated skip-pan (box), dragline bucket, clamshell, rock-bucket, hydraulic excavator ("Gradall"), trackhoe, or other approved equipment. The use of tractor loaders or other equipment commonly referred to as front end loaders shall not be permitted. Pneumatic tired front end loaders may be used provided that in the opinion of the Contracting Officer no degradation of the rock occurs. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid displacing the bedding material. The large stones shall be well distributed and the entire mass of stones in their final position shall be graded to conform to the gradation specified in paragraph RIPRAP, subparagraph GENERAL. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Placing riprap in layers will not be permitted. Placing riprap by dumping it into chutes, or by similar methods likely to cause segregation of the various sizes, shall not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope shall not be permitted. No equipment shall be operated directly on the completed stone protection system. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during

final placing; or by other methods of placement which will produce the specified results. Each truckload shall be representative of the gradation requirements. All dump trucks used in placing the riprap shall be equipped with bottom hinged tailgates. The gate releasing mechanism shall be arranged so that it may be operated only from, at, or near the front of the truck. Rearranging of individual stones shall be required to the extent necessary to obtain a well-graded distribution of stone sizes as specified above. However, manipulating stone by means of dozers or other blade equipment shall not be permitted. Unless otherwise authorized by the Contracting Officer, riprap shall be placed in conjunction with the construction of the embankment and with only sufficient lag in construction of the stone protection as may be necessary to prevent mixing of embankment and stone protection materials. The Contractor shall maintain the stone protection until accepted by the Contracting Officer and any material displaced prior to acceptance and due to the Contractor's negligence shall be replaced at his expense and to the lines and grades shown on the contract drawings.

-- END OF SECTION--

SECTION 02431

PIPE JACKING CONCRETE PIPE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API RP 13B-1	(1997) Standard Procedure for Field Testing Water-Based Drilling Fluids
API RP 13B-2	(1998) Field Testing Oil-Based Drilling Fluids

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 33	(1993) Concrete Aggregates
ASTM C 76	(1998) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 94	(1998) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 270	(1997ael) Mortar for Unit Masonry
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

(Metric)

ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 828	(1998) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989; R 1997) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

ENGINEERING MANUALS (EM)

EM 385-1-1	(1992) U.S. Army Corps of Engineers Safety and Health Requirements Manual

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(1999) Manual for Railway Engineering (4 Vol.)

1.2 GENERAL REQUIREMENTS

No earth displacement or settlement greater than 1/8" is allowed under road earth or pavement locations. The Contractor will be required to repair any settlement effects to the roads.

The construction required herein shall include minor appurtenant structures. Excavation and backfilling is specified in Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the concrete pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

This section describes the equipment, materials, and procedures to perform concrete pipe and pipe jacking work.

1.2.1 JACKING:

1.2.1.1 General:

Where indicated on the drawings, a combination of jacking and excavation shall be used to install pipe. Excavation shall be any approved method. Excavation without concurrent jacking will not be permitted. The trenches in the side slopes of the road embankment at the limits of the jacked portion of the pipe shall be sheeted and braced to protect against caving. Road traffic shall not be interrupted.

1.2.1.2 Schedule of Operations:

The Contractor shall submit his schedule of operations and methods of installation for approval prior to jacked, commencement of jacking operations. The schedule submitted shall have the prior approval of the State of Missouri Highway Dept of Transportation.

1.2.1.3 Controlled Low Strength Material (CLSM)

Once the work has been completed, the old 18" x 30" storm drain and approximately 180 lineal feet of arched storm drain pipe shall be abandoned and filled with Controlled Low Strength Material (CLSM). The CLSM shall be a Portland cement concrete designed to provide a flowable or pumpable backfill. The CLSM shall be capable of filling the entire void space in drains and pipes to be filled. The CLSM, shall conform to the requirements for concrete specified in Section 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, except as modified herein. The CLSM shall have a compressive strength of at least 1,000 psi at 28 days, and designed to compensate for shrinkage. The CLSM for drain and pipe filling and closures shall conform to the shrinkage compensation requirements listed in ASTM C 1107 Table 1, Grade C. The nonshrink grout shall be produced from the CLSM and tested during mix design. The coarse and fine aggregate used in producing CLSM shall be produced from a Burlington Limestone source listed in Section 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. The aggregate shall be tested and certified as conforming to the quality requirements specified in Section 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, paragraph 2.1.2 Aggregates. The mix design shall be submitted for approval.

a. Production and Placement of CLSM

The CLSM shall be produced, placed, cured and protected in accordance with the requirements for concrete in accordance with Section 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, except as otherwise specifically approved in writing. The CLSM for drain and pipe filling shall be placed to ensure that a constant head of concrete is maintained on the placement to an elevation of at least 1 foot above the highest elevation within the placement void volume until the CLSM has achieved a compressive strength of at least 500 psi.

b. Surface preparation

Preparation of surfaces to be in contact with CLSM concrete shall conform to the requirements of Section 03301, CAST-IN-PLACE STRUCTURAL CONCRETE FOR

CIVIL WORKS.

1.2.2 GEOTECHNICAL SITE CONDITIONS

1.2.2.1 Exploratory Borings

Subsurface exploratory borings were advanced in the immediate area of, but not specifically at the pipe jacking site. Locations of the area borings are shown on the plans and the logs of those borings which fall close to the area of this contract are included in drawings for the convenience of the Contractor. The Government assumes no responsibility for interpretation or deductions made by the Contractor from the logs and borings. Local minor variations in the subsurface materials are to be expected and, if encountered, will not be considered as being materially different within the purview of this work. Soils classifications shown on the logs are the result of field visual classifications in accordance with the Unified Soils Classification System.

1.2.3 PERFORMANCE REQUIREMENTS

The Government may perform quality assurance testing on the controlled low strength material, concrete pipe and pipe jacking and backfill materials using the laboratory and equipment furnished by the Contractor. The Government testing will in no way relieve the Contractor of the responsibility of performing tests necessary to meet the construction requirements. The Contractor shall provide the equipment and laboratory space to government personnel on demand and these services shall be considered a subsidiary obligation of the construction. All routine testing procedures being conducted by the Contractor shall be available for inspection by the Contracting Officer at any time.

1.2.4 DEFINITIONS

The terms used in this section are defined as follows:

1.2.4.1 Concrete Pipe and Pipe Jacking

The pipe jacking is a method to place concrete pipe through the existing ground or prepared working surface using the concrete pipe and pipe jacking method of excavation and backfilled with a specified mixture of soil.

1.2.4.2 Concrete Pipe and Pipe Jacking Specialist

A concrete pipe and pipe jacking specialist is an individual who has had two years of experience in concrete pipe and pipe jacking construction and has knowledge in all aspects of concrete pipe and pipe jacking construction which includes but is not limited to:

Trench excavation and backfill procedures; and,

A thorough knowledge of construction equipment and material testing required for concrete pipe and pipe jacking construction.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data.

Equipment; G

The Contractor shall submit data on the equipment to be used in the construction concrete pipe and pipe jacking work and, equipment to be used in the Contractor's quality control testing.

Controlled Low Strength Material; G.

The Contractor shall submit mix design for controlled low strength material backfill, including all supporting test data on composition, strength, permeability and density.

Concrete Pipe and Pipe Jacking Construction; G.

The layout of operations for the construction of the concrete pipe and pipe jacking shall include but is not limited to drawings depicting controlled low strength material storage area, concrete pipe and pipe jacking preparation area, hydration pond(s) concrete pipe and pipe jacking storage area, backfill storage and mixing area, location and sizes of all stationary equipment, water storage tanks, pumps, valves, lines, hoses, and materials, and waste areas.

SD-04 Drawings

Concrete Pipe and Pipe Jacking Construction; G.

The layout of operations for the construction of the concrete pipe and pipe jacking shall include but is not limited to drawings depicting controlled low strength material storage area, concrete pipe and pipe jacking preparation area, hydration pond(s) concrete pipe and pipe jacking storage area, backfill storage and mixing area, location and sizes of all stationary equipment, water storage tanks, pumps, valves, lines, hoses, and materials, and waste areas.

SD-09 Reports

Tests; G.

The Contractor shall submit the results of all Contractor Quality Control tests and measurements.

SD-13 Certificates

Qualifications; G.

The Contractor shall submit evidence that the controlled low strength material grouting specialist or grouting foreman has had at least 3 years experience within the past 5 years on similar grouting type projects.

Grouting Equipment; GA-RE.

A plan of the proposed controlled low strength material grouting equipment types and layout shall be submitted for approval.

Grout Application; GA-RE.

The Contractor shall submit the method to be used in applying the controlled low strength material grout.

Qualifications; G.

The Contractor shall submit evidence that he or his subcontractor is competent in concrete pipe and pipe jacking construction; and, the credentials of the concrete pipe and pipe jacking specialist shall be submitted eight weeks prior to the start of the concrete pipe and pipe jacking construction. This evidence will insure that the Contractor or his subcontractor will have sufficient competent personnel to carry out the operations specified and such personnel shall have experience in this type of construction. In particular, a concrete pipe and pipe jacking specialist shall be employed by the Contractor.

Concrete Pipe and Pipe Jacking Construction; G.

The Contractor shall submit the methods to be used in the concrete pipe and pipe jacking construction.

Samples of Impervious Stratum; G.

The Contractor shall submit procedures to obtain impervious stratum samples.

Tests; G.

The Contractor shall submit the procedures to be used in quality control testing.

SD-09 Reports

controlled low strength material; G.

The Contractor shall submit mix design for controlled low strength material backfill, including all supporting test data on composition, strength, permeability and density.

Tests; G.

The Contractor shall submit the results of all Contractor Quality Control tests and measurements.

Drilling Operations; G.
Pressure Washing and Pressure Testing Operations; G.
Cement and controlled low strength material Grouting Operations; G.

The Contractor shall submit in duplicate records of all grout hole and drain hole drilling operations, all pressure washing and pressure testing operations and all cement and controlled low strength material grouting operations. The originals of all such records shall be submitted to the Contracting Officer before final payment is made.

SD-13 Certificates

Portland Cement; GA-RE.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and other precast parts.

Joints; GA-RE.

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans as required are oil resistant.

Backfill; RE.

The Contractor shall submit the gradation of all imported borrow material which includes borrow area or commercial sources, laboratory certification of the physical characteristics of the soil including grain size analysis and Atterberg limits.

Concrete Pipe and Pipe Jacking Specialist; G

Qualifications for the concrete pipe and pipe jacking specialist shall provide supervision and control of composition, mixing, placing, cleaning, and maintenance of the concrete pipe and pipe jacking specialist shall be on site at all times during trenching and backfilling operations.

1.3.1 REGULATORY REQUIREMENTS

The regulatory requirements listed below form a part of this specification to the extent referenced. The regulatory requirements are referred to in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS' ENGINEERING MANUALS (EM)

EM 1110-2-2901	(Sep 1978; Ch 1, Feb 1982) Tunnels and Shafts in Rock

1.4 JACKING PIPE

Concrete pipe shall be used for jacking and shall be tongue and groove design. The tongue shall be at the downstream end. Jacking frames shall be so constructed as to avoid breaking the pipe or out of alignment. The pipe shall preferably be jacked upgrade in order to provide drainage during

excavation. Satisfactory means shall be provided for maintaining the lead pipe at the correct line and grade.

The pipe shall be installed according to specially prepared construction plans and specifications by the Contractor. The Contractor shall use a registered Engineer in the State of Missouri to create the documents. The Contractor set forth the construction procedure, extra pipe reinforcement and jack shield (if required) jacking pit location and shoring, and other special features for the safe and satisfactory he work. The Contractors Engineer shall submit plans prepared by the contractor giving the construction details for review by the Engineer.

The Contractor shall grout the voids created by excavation during jacking operations if determined necessary by the Contracting Officer. Grout locations shall be recorded and a copy provided to the Contracting Officer upon completion of the work.

The contractor crew must continually monitor elevation and alignment of the road above during procedures. Jacking must be stopped and any problems corrected if road movement is detected.

The contractor shall set forth the construction plans and other necessary details and submit them for review by the Engineer.

The pipe can be pushed forward immediately after the soil is excavated, providing a completed tunnel liner for protection of workers and equipment.

1.5 PROCEDURE

General procedures for jacking concrete pipe sequence for tunneling and jacking concrete pipe are as follows:

Excavate jacking pits or shafts, construct jacking abutments or thrust blocks, and install jacks, jacking frame and guide rails.

Begin tunnel excavation by machine, or hand, depending on conditions.

Lower first section of pipe, position jacks and jacking frame, and jack pipe forward.

Continue excavation, remove soil through pipe, insert succeeding sections of pipe between the lead pipe and jacks and jack forward.

Repeat sequence, excavation, soil removal, pipe insertion and jacking, until the operation is complete.

1.6 Measurement and Payment

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Concrete Pipe

Push concrete pipe shall be reinforced and conform to ASTM C 76, Class III (THREE) or greater. Pipe shall be tongue and groove type, or modified tongue and groove type.

2.1.2 Portland Cement For Concrete Pipe and Fittings

Portland cement shall conform to ASTM C 150, Type III for concrete used in concrete pipe, concrete pipe fittings. Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 Fittings for Concrete Pipe

ASTM C 76 for pipe.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil resistant.

2.3.1 Concrete Pipe Jointing

Joints and gaskets shall conform to ASTM C 443.

2.4 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.5 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to ASTM C 94. Concrete used for cradle and encasement shall have a compressive strength of 4000 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days. ASTM C 33 for Concrete Aggregates

2.6 OTHER MATERIALS

The requirements for the materials to be utilized in the concrete pipe and pipe jacking construction are as follows:

2.6.1 Water

The Contractor shall supply all water required for mixing with controlled low strength material to produce slurry. The water shall be clean, fresh, and comply with the standards specified below:

a. A pH equal to 7.0 plus or minus 1.0 .

b. Total dissolved solids not greater than 500 parts per million.

c. Oil, organics, acids, alkali, or other deleterious substances not greater than 50 parts per million each.

d. Hardness less than or equal to 50 ppm.

The Contractor shall furnish water quality test results for water used for mixing the controlled low strength material concrete pipe and pipe jacking to assure conformance with the above limits.

2.6.2 Additives

Admixtures of the types used in the control of oil field drilling muds such as thinners, dispersants, and flocculants may be used to control standard properties of the slurry for the concrete pipe and pipe jacking such as apparent viscosity and filtration characteristics subject to approval. Peptizing or bulking agents shall not be mixed with the slurry.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe

manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

3.1.2.1 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.2 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade.

3.1.2.3 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.4 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.5 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle or encased in concrete where day lighted on both ends. It shall run from the day lighted end to three foot after the first joint which is fully entombed by the embankment two foot from top pipe to grade line. The day lighted end shall also have a one foot thick cast in place cutoff wall from one foot top of pipe to three feet below grade line at bottom of pipe. The cut off wall shall extend twenty four inches on each side of the pipe. The full total height is six feet plus the pipe wall thickness. The full width is four feet plus the pipe wall thickness. The contractor shall design the 4000 psi at 28 days concrete design mix, concrete reinforcement and footing by a Professional Engineer in the State of Missouri.

3.3 WASTE WATER and GROUT

Grout that cannot be placed or injected prior to initial set or maximum specified time limit shall be wasted. During the progress of the work, the Contractor shall provide for adequate disposal of all wash and waste water

and remove all waste grout, on a daily basis if necessary, to maintain a safe and effective grouting operation.

3.4 RECORDS

The Contractor shall prepare on a daily basis records of all controlled low strength material grout hole and drain hole drilling operations, all pressure washing and pressure testing operations and all cement and controlled low strength material grouting operations. These records shall include: driller's logs of all controlled low strength material grout holes, drain holes, and exploratory holes; pressure washing information and pressure testing results; grouting data including time of each change of operation, rate of pumping, grouting pressures, changes in water-cement ratio, changes in proportions of additives such as fluidifier, accelerator, or sand, and amounts of various materials injected ; and other data considered necessary as determined by the Government Representative. Blank report forms of the type to be used are attached at the end of this specification.

3.5 CONTRACTOR QUALITY CONTROL

In accordance with Section 01451 CONTRACTOR QUALITY CONTROL, quality control shall be established and maintained which shall specifically include, but not be limited by, inspections to assure that:

a. The specified qualification requirements are met.

b. Drilling and grouting equipment is provided as specified and maintained in satisfactory condition.

c. The required amount of cement is kept on hand during grouting operations.

d. Grouting is performed in the presence of a Government Representative.

e. Required records are kept and submitted as specified.

f. Accurate cement grout mixture proportions are maintained as recommended by the manufacturer or supplier.

g. Materials are properly protected from moisture and contamination after delivery and transportation to the site.

h. Only approved materials are used.

i. The quantity of bulk materials used equals the computed amount.

3.6 PREPARATION

3.6.1 Equipment

The Contractor shall furnish all necessary plant and equipment for efficiently stripping, cutting, and/or filling to form the slurry-mixing

and equipment-operating surface; excavating the trench; mixing and placement of backfill; disposal of undesirable excavated material in accordance with other provisions of this contract; and, preparation for and placement of the final cap on the completed trench, and for quality control testing of the materials used in such process.

3.6.1.1 Trench Excavation

Equipment for excavating the trench shall be any type of earth moving or drilling equipment capable of performing the indicated work on the drawings and/or as specified. The equipment shall be that which reduces live-load surcharge to a level that will produce no significant contribution to the instability of the trench. Regardless of the equipment type used, it shall be capable of excavating the required work.

3.6.1.2 Mixing and Placing concrete pipe and pipe jacking

Concrete pipe and pipe jacking mixing and placing equipment will be approved by the Contracting Officer. The concrete pipe and pipe jacking mixing plant shall be equipped with a high-speed/high-shear, colloidal mixer or a high-velocity/high pressure venturi jet mixer used in conjunction with a high-speed/high-shear centrifugal pump. The plant shall be equipped with a mechanically or hydraulically agitated sump and shall include pumps, valves, hoses, supply lines, tools, and other equipment and materials required to prepare the concrete pipe and pipe jacking and deliver it in a continuous supply from the hydration location to the concrete pipe and pipe jacking operations. The Contractor shall have sufficient ponds and pits for storage of hydrated controlled low strength material slurry. The ponds and pits shall be mechanically or hydraulically agitated.

3.6.1.3 Cleaning of concrete pipe and pipe jacking

Concrete pipe and pipe jacking cleaning equipment shall include but not be limited to a vibratory shaker screen, centrifugal sand separator, and/or stilling ponds.

3.7 CONTROLLED LOW STRENGTH MATERIAL CONSTRUCTION

3.7.1 General

The concrete pipe and pipe jacking shall be constructed to the elevations, lines, grades, and cross-sections shown and in accordance with these specifications, unless otherwise directed. The Government may modify the dimensions and quantities of the work as determined necessary. The Contractor shall submit a general work sequence schedule and layout plan of operations for approval, a minimum of four weeks prior to the start of construction.

3.7.2 Placement of concrete pipe and pipe jacking

Concrete pipe and pipe jacking shall be introduced into the trench at the time excavation begins. The level of the concrete pipe and pipe jacking in open trenches shall be at all times maintained a minimum of 2 feet above

ground water level and no more than 1 foot below the working surface until the placement of backfill material is complete. The Contractor shall have sufficient personnel, equipment, concrete pipe and pipe jacking storage areas, and stored concrete pipe and pipe jacking materials ready to raise the concrete pipe and pipe jacking level at all times in the excavated trench during construction within the limitations specified and subparagraphs thereof. To this end, the Contractor shall have personnel on call to raise the concrete pipe and pipe jacking level at any time this occurs, weekends and/or holidays included. Dilution of concrete pipe and pipe jacking by surface waters shall be prevented. The quality of the concrete pipe and pipe jacking shall be maintained at all times, including periods of work stoppage, in a condition which meets the requirements set forth.

3.7.3 Excavated Material

Material excavated from the trench (meeting the requirements of BACKFILL, shall be used in the backfill. Material to be used in the backfill shall be stockpiled for subsequent processing in approved areas. Upon completion of waste operations, the waste areas shall be seeded in accordance with Section, SEEDING.

3.7.4 Backfilling Trench in Case of High Water

In the event the ground water rises or is expected to rise to within 1 foot of the top of the working surface, the Contracting Officer reserves the right to require the Contractor to stop excavation and to begin continuous operations to either dike around the open trenches and raise the concrete pipe and pipe jacking levels or to fill all or part of the open trenches with concrete pipe and pipe jacking backfill mixed and placed as specified in the specifications. Continuous operations shall consist of expeditiously performing the required operations twenty-four hours per day until the operations are completed or the water level falls to a depth of more than 1 foot below the top of the working surface.

3.7.5 Cleanup

Removal of all excavation spoil, unused backfill, and concrete pipe and pipe jacking shall be accomplished following completion of final backfilling and trench site compacting and grading. These materials will be disposed of offsite. During final disposal of the slurry, the material shall be flocculated to separate the controlled low strength material from the water. The flocculated controlled low strength material material shall be placed in the designated disposal areas and the water shall be disposed of in an approved manner.

3.8 TESTS

The Contractor shall be responsible for project quality control records. Observation, measurements, and tests described in these specifications shall be performed for quality control. All quality control records, routine testing procedures, observations, and measurements shall be available for inspection at any time.

3.8.1 Not Used.

3.8.2 Records

Records shall be maintained by the Contractor for all testing, measurements, and inspections performed to ascertain that the concrete pipe and pipe jacking construction meets the specifications. Required reports, records, and documentation shall be furnished to the Government daily. The Contractor's required records are outlined below.

3.8.2.1 As-Built Profile

An as-built profile of the trench bottom, backfill slopes including descriptions of materials encountered in the trench bottom shall be continuously maintained by the Contractor. This profile shall indicate extent of excavation.

3.8.2.2 Results

The results of all construction control testing required in these specifications, including water tests, concrete pipe and pipe jacking tests, and backfill tests shall be furnished by the Contractor. The Contractor shall furnish records of all observations, measurements, and tests performed, identified with the location and time of testing. These records shall be furnished no later than 48 hours after the tests, measurements, and/or observations were made.

3.8.2.3 Construction Log

The Contractor shall maintain a construction log of daily activities which shall include delays encountered during construction, causes of delays, locations of affected areas, and extent of delays. The log shall also record unusual conditions or problems encountered, and the dispositions made.

-- End of Section --

SECTION 02456

STEEL H-PILES
02/98

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

1.1.1 Section, LEVEE CONSTRUCTION AND EARTHWORK

1.1.2 Section, EXCAVATION, TRENCING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 370	(1997a) Mechanical Testing of Steel Products
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 706	(1993) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM D 1143	(1981; R 1994e1) Piles Under Static Axial Compressive Load
ASTM D 3689	(1990) Individual Piles Under Static Axial Tensile Load
ASTM D 3966	(1990) Piles Under Lateral Loads
ASTM D 4945	(1989) High Strain Dynamic Testing of Piles

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Pile Driving Equipment; GA-GL.

Descriptions of pile driving equipment shall be submitted for approval at least 30 days prior to commencement of work. The equipment submittal shall include results of the Contractor's WEAP analysis in support of the equipment's viability in meeting the requirements of this contract action as described in paragraph "PILE DRIVING EQUIPMENT" of this specification section.

Pile Testing Subcontractor; GA-EC.

The proposed pile testing subcontractor along with appropriate resumes shall be submitted for approval at least 30 days prior to commencement of work.

Pile Driving Records; GA-RE.

The proposed forms and database for compiling pile driving records shall be submitted for approval 30 days prior to commencement of work.

Delivery, Storage and Handling; GA-GL.

Delivery, storage and handling plans for piles shall be submitted for approval at least 30 days prior to delivery of piles to the job site.

Pile Tests; GA-GL.

A pile load test plan shall be submitted for approval at least 30 days prior to installing any test piles. Approval of the plan shall not relieve the Contractor of the responsibility for structural and operational adequacies of the testing system.

MATERIALS; GA-GL.

Material orders, materials lists and materials shipping bills.

SD-04 Drawings

Pile Splices; GA-EC.

Detail drawings of pile splices must be submitted and approved 30 days prior to pile installation.

Pile Placement; GA-GL.

A pile placement plan shall be submitted for approval at least 30 days prior to delivery of piles to the job site.

SD-09 Reports

Mill Inspection; GA-EC.

The Mill Inspection Report shall be submitted for approval 30 days prior to the manufacture of any H-piles for this project.

Pile Driving Tests; GA-GL.

Pile driving test data shall be submitted for approval within 1 day after each test is completed.

Pile Driving Analyzer; GA-GL.

Pile driving analyzer data, including CAPWAP analyses, shall be submitted for approval within 1 day after each test is completed. This shall also include all raw data on floppy disc, as well as all field logs.

Pile Load Tests; GA-GL.

Four handwritten copies of the load test report for each pile tested shall be submitted within 1 day after the load test is completed. Fax copies to: Kansas City District, Local Protection Section, (816) 426-5462. Typed formal reports shall be submitted within 5 days after completion of all test piles at each structure location. The Load Test Report shall, at a minimum, contain all information listed herein plus as listed in paragraph 8 of ASTM D 1143 for compressive pile tests, paragraph 9 of ASTM D 3689 for tensile load tests, and paragraph 9 of ASTM D 3966 for lateral load tests.

SD-18 Records

Pile Driving Records; GA-GL.

Fully completed pile driving records shall be submitted daily.

1.4 DELIVERY, STORAGE, AND HANDLING

Delivery, storage and handling of materials shall conform to the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Plans for the delivery, storage and handling of piles shall be developed and submitted for approval.

1.4.1 Delivery and Storage

Piles shall be stacked during delivery and storage so that each pile is maintained in a straight position and is supported along its length, ends inclusive, per the approved submittal, to prevent exceeding the maximum camber or sweep. Piles shall not be stacked more than 5 feet high unless approved by the Contracting Officer.

1.4.2 Handling

Point pick-up devices shall be of the type that clamp to both pile flanges at each pick-up point. Holes may be burned in the flanges or webs of piles above the cutoff location for lifting piles into the leads provided it does not lead to damage of the pile during driving. Piles shall not be dragged across the ground. The Contractor shall inspect piles for excessive camber and sweep and for damages before transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Camber, curvature in the pile in the direction normal to the pile flanges, shall be measured with the pile flange base laying on a flat surface and shall be the distance between the flange base at the mid-length of the pile and the flat surface. Sweep, curvature in the pile in the direction

parallel to the pile flanges, shall be measured with the pile flange tips laying on a flat surface and shall be the distance between the flange tips at the mid-length of the pile and the flat surface. The maximum permissible camber and/or sweep shall be

3/8 in. + {1/8 in. x ({total length ft. - 45}/10)}

over the length of the pile. Piles having excessive camber or sweep will be rejected.

1.5 PERSONNEL

1.5.1 General

The Contractor shall engage the services of a specialized pile testing subcontractor to perform all aspects of the required pile testing program. This subcontractor must be specialized in the field of pile testing and shall have proven expertise to perform all pile testing specified. The use of an additional specialized subcontractor, under the direction of the pile testing subcontractor, to perform and evaluate the test using the PDA will be permitted.

1.5.2 Qualifications

The pile testing subcontractor shall provide a field engineer who shall be on site full time during the pile driving activities for the project. This field engineer shall, at a minimum, have a Bachelor of Science Degree in Civil Engineering with a minimum of three years experience devoted to the monitoring of foundation pile installations. The field engineer shall be experienced in the use of a PDA and in performing pile load tests. The field engineer shall be a Registered Professional Engineer. A second engineer with the same qualifications will be required if the operation is scheduled on a multi-shift basis or extends over multiple shifts. In addition, the pile testing subcontractor shall identify a pile testing supervisor who shall be a principal of the firm with at least ten years experience in geotechnical engineering, of which at least five years experience has been devoted to the design and testing of pile foundations for major construction projects. The Contractor shall submit the name of the proposed pile testing subcontractor within 10 days of the date of contract award. The Contractor shall, in his submittal, outline the experience of the subcontractor and name the proposed field engineer, the proposed supervisor, and shall provide detailed resumes for each. If an additional subcontractor is to be used for testing with the PDA, the submittal shall name the firm and include resumes of all individuals who will be operating the equipment and performing the analysis of the data in full or part. If the subcontractor and individuals meet the Government's approval, the Contractor shall be so notified within 30 days after receipt of the qualifications.

1.5.3 Responsibility

The pile testing subcontractor shall be responsible for the performance of all pile tests specified herein. This includes the compressive, tensile, lateral, and pile driving tests. The pile testing subcontractor shall be responsible for performing or administering dynamic testing of piles. The pile testing subcontractor shall be responsible for preparation of all submittals related to pile testing and of reports showing the results of all tests performed. The reports must include an analysis of the data and a presentation of conclusions.

PART 2 PRODUCTS

2.1 MATERIALS

Material orders, materials lists and materials shipping bills shall conform to the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.1.1 Steel

Steel for H-piles shall be 50 ksi yield strength and shall conform to ASTM A 572/A 572M.

2.1.2 H-piles

H-piles shall be of the shape and sections shown on the drawings (HP14 x 102) and shall have standard square ends unless otherwise directed. Lengths of piles shall be as determined by pile testing as specified herein.

2.2 FABRICATION

Fabrication shall conform to the requirements shown on the drawings and specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.2.1 Pile Splices

Detail drawings of pile splices shall be submitted for approval.

PART 3 EXECUTION

3.1 SITE PREPARATION

All pile driving sites included in this contract action shall be prepared by the Contractor per Specification Section, LEVEE CONSTRUCTION AND EARTHWORK and Section, EXCAVATION, TRENCING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES.

3.2 PILE DRIVING EQUIPMENT

The Contractor shall select the proposed pile driving equipment, including hammers and other required items, and shall submit complete descriptions of the proposed equipment for approval including all information listed in paragraph 3.1.1.1. of this specification section. The Contractor shall perform a wave equation analysis using the most current version of Wave Equation Analysis for Piles (WEAP) program or other approved computer program, on the proposed driving system at least 14 days prior to installation of the first test pile at each structure location prior to submittal to substantiate equipment viability in meeting project requirements. The results of the analysis must be included in the pile driving equipment submittal. The pile driving system must be capable of developing the required maximum ultimate load without exceeding 15 blows per inch and 90% of the specified yield stress of the pile. The pile driving equipment must be capable of re-driving piles if there is an interruption during installation. The Contractor should be aware that

there may be significant soil set-up if driving of a pile is not continuous. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be permitted by the Government after the equipment has been approved by the Contracting Officer except as specified herein. No additional contract time will be allowed for Contractor-proposed changes in the equipment.

3.2.1 Pile Driving Hammers

Pile driving hammers shall be of the impact type.

3.2.1.1 Impact Hammers

Impact hammers shall be steam, air, hydraulic, or diesel hammers of the single acting, double-acting, or differential acting type. The size or capacity of hammers shall be determined by the Contractor as specified in paragraph "Site Preparation." Hammers shall be capable of driving to 20 blows per inch. Boiler, compressor, or engine capacity shall be sufficient to operate hammers continuously at the full rated speed. Hammers shall be equipped with a gage to monitor hammer bounce chamber pressure for closed-top diesel hammers or pressure at the hammer supply line for air and steam hammers. This gage shall be operational during the driving of all piles, both test and production, and shall be mounted in an accessible location to allow safe monitoring by the Contractor and the Contracting Officer. Two spare operational bounce chamber read out units shall be available on site. Damaged or non-operating bounce chamber pressure gages shall be immediately replaced by the Contractor upon discovery. The Contractor shall provide bounce chamber pressure gage correction tables and charts for the type and length of hose to be used with the pressure gage to the Contracting Officer. The hammer must be clearly marked at all times to identify the magnitude of the rated stroke and manufactures recommended position of the stroke. The Contractor shall arrange for a representative of the hammer manufacturer to visit the site during initial test pile driving to inspect and verify that the hammer is operating to the manufacturers specifications. The manufacturer's representative shall provide a letter report of his findings to the Contracting Officer. The Contractor shall submit the following information for each impact hammer proposed:

a. Make and model.

b. Ram weight (pounds).

c. Anvil weight (pounds).

d. Rated stroke and range of stroke for variable stroke hammers (inches).

e. Rated energy range (foot-pounds).

f. Rated speed (blows per minute), chart of speed vs. stroke for open-top diesel hammers.

g. Steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch).

h. Rated energy vs. bounce chamber pressure curves or charts,

including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch).

i. Pile driving cap, make, dimensions, and weight (pounds).

j. Cushion block dimensions and material type, modulus of elasticity, coefficient of restitution, and supporting test data.

k. Power pack description and specifications

l. Hammer Operation Manual

m. Hammer Maintenance/Parts Manual

n. Identify any modifications that have been made to the hammer that make it different from the manufacturers standard

3.2.2 Pile Driving Leads

Hammers shall be supported and guided with fixed leads supported at a minimum of 2 points during driving. Sentence Deleted. The leads shall be longer than the pile being driven.

3.2.3 Jetting

Jetting of piles is not permitted.

3.3 INSTALLATION

3.3.1 Lengths of Permanent Piles

The estimated quantities of piles listed in the unit price schedule are given for bidding purposes only. After completion of pile load testing and pile driving testing, the Contractor shall evaluate the results and submit a schedule showing the proposed lengths of piles for each contract structure. The proposed length shall be measured from estimated tip to cutoff elevation plus an additional five feet. All piles shall be driven to the minimum embedment (possess the minimum length) as determined by load testing and have the minimum design capacities as listed in the table below.

Monolith Designation	Pile Rows	Number of Piles	Estimated Design Embedment Length1 (feet)	Minimum Design Compress. Capacity (kips)	Minimum Design Tensile Capacity (kips)	Minimum Design Lateral Capacity (kips)	Load Tests Required
Stoplog Closure Site Q0:							
Center	1	20	44.6	---	7.9	15	L
	2	20	46(bat)	24.9	---	21	
M21	1	4	44.6	---	7.9	15	
	2	4	46(bat)	24.9	---	21	
M22	1	4	44.6	---	7.9	15	
	2	4	46(bat)	24.9	---	21	

Monolith Designation	Pile Rows	Number of Piles	Estimated Design Embedment Length1 (feet)	Minimum Design Compress. Capacity (kips)	Minimum Design Tensile Capacity (kips)	Minimum Design Lateral Capacity (kips)	Load Tests Required
Rolling Gate Site Q1:							
Closure	1,7	7	45	21	22	25	
	2-6	22	50	123	43	56	CTL
Center	1	13	60	138	---	---	
	2	13	60	153	---	---	
Storage	1	11	40	---	17	27	
	2	15	45	---	---	50	
	3	5	50	110	---	---	
Corner	1	2	40	---	25	18	
	2-5	14	45	93	51	40	
Rolling Gate Site Q3:							
Abutments	1	10	45	---	58	15	T
	3	8	46.4(bat)	123	---	32	CL
	5	8	46.4(bat)	123	---	32	
Center	2	9	45	123	---	15	
	5	9	46.4(bat)	123	---	23	
Storage	2	10	45	---	58	15	
	4	10	46.4(bat)	123	39	39	
	5	10	46.4(bat)	123	39	39	
Stoplog Closure Site Q3A:							
Center	1	11	40.6	---	11.6	27.4	
	2	11	40.6	26.2	---	27.4	L
M28	1	5	40.6	---	11.6	27.4	
	2	5	40.6	26.2	---	27.4	
M29	1	5	40.6	---	11.6	27.4	
	2	5	40.6	26.2-	---	27.4	
Stoplog Closure Site R1A:							
Center	1	15	40.6	---	13.9	27.2	L
	2	15	41.9(bat)	40	---	36.6	
M25	1	5	40.6	27.2	---	18.3	
	2	5	41.9(bat)	141	---	18.0	C
M26	1	5	40.6	27.2	---	18.3	
	2	5	41.9(bat)	141	---	18.0	

C - Compressive Load Test Required

T - Tension Test Required

L - Lateral Load Test Required

1. To be confirmed by pile load testing as herein specified.
2. Stoplog Closure piles at Q0 shall be driven to refusal. One lateral load test required. No PDA load testing required at this location.

The Contractor shall base his bid on the assumption that the driving criteria for all piles is that required to obtain design compressive and tensile capacities as listed in the above table. The proposed lengths shall be submitted for individual monoliths after all load tests are complete and the driving tests are completed. The piles may not be ordered until the lengths of permanent piles are approved by the Contracting Officer.

3.3.2 Pile Driving Records

Pre-drilled starter holes may be required for penetrating through extra hard natural strata or rolled fills. Drilling or augering will be permitted only with the approval of the Contracting Officer. The hole shall be 2 inches less in diameter than the diagonal dimension of the pile and shall be backfilled with granular material after installation of the pile. The drilling or augering shall not be deeper than required to bypass the obstructing layer.

3.3.3 Pile Placement

A pile placement plan which shows the installation sequence and the methods proposed for controlling the location and alignment of piles shall be developed and submitted for approval. The plan shall identify each pile with a unique designation. Foundation preparation shall be completed according to Section, LEVEE CONSTRUCTION AND EARTHWORK and Section, EXCAVATION, TRENCING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES prior to the placement of piles for driving. Piles shall be placed accurately in the correct location and alignments, both laterally and longitudinally, and to the vertical lines indicated. The Contractor shall establish a permanent base line to provide for inspection of pile placement by the Contracting Officer during pile driving operations. The base line shall be established prior to driving permanent piles and shall be maintained during the installation of the permanent piles. A stake shall be placed at the location of each pile with the pile designation clearly marked. A final lateral deviation from the correct location at the cutoff elevation of not more than 3 inches will be permitted for piles. A final variation in alignment of not more then 1/4 inch per foot of longitudinal axis will be permitted. A final variation in rotation of the pile about the center line of the web of not more than 7.5 degrees will be permitted. A vertical deviation from the correct cut off elevations shown on the drawing of not more than 0-inches above to 2-inches below will be permitted. The correct relative position of all piles shall be maintained. Piles not located properly or exceeding the maximum limits for lateral deviation and/or variation in alignment shall be rejected and no payment will be made for these piles. Replacements for such rejected piles will be installed by the Contractor at locations directed by the Contracting Officer.

3.3.4 Pile Penetration Criteria

The piles shall be driven to at least the minimum embedment as determined from the pile load testing program and to the required final blow count as determined from the dynamic testing program. It is the responsibility of the Contractor to provide a pile driving system that will efficiently drive the piles to the required depth and blow count. The controlling depth of penetration and blow count (number of blows required to attain the final inch of penetration) for permanent piles will be determined subsequent to the analysis of pile tests as specified in paragraph 3.3 PILE TESTS. If a pile reaches the required final blow count prior to the minimum penetration depth, driving of the pile shall continue until the pile is driven to refusal (20 blows per inch for 3 inches) or to the minimum specified embedment, whichever first occurs. The Contracting Officer must approve any pile that does not have minimum penetration for inclusion in the permanent work. Any pile that has been driven to grade without reaching the required blow count shall be spliced and driven until the required blow count is obtained. The Contractor should be aware that re-driving of piles after any interruption may be difficult due to the potential for soil setup.

3.3.5 Pile Driving

The Contracting Officer shall be notified 30 days prior to the date pile driving is to begin. Piles shall not be driven within 100 feet of concrete less than 7 days old unless otherwise authorized. Permanent and test piles shall be driven with hammers of the same model and manufacturer, same energy and efficiency, and using the same driving system. Hammers shall be operated at the speed and under the conditions recommended by the manufacturer subject to the approval of the Contracting Officer. All piles shall be clearly marked in 1 foot increments with 1 inch increments within 5 feet of the design tip elevation, prior to driving. Where heave is anticipated, the sequence of installation shall be such that pile heave is minimized. Prior to driving and with the pile top seated in the drive head, each pile shall be checked to ensure that it has been aligned correctly. Once pile driving has begun, pile alignment shall be kept constant. Each pile shall be driven continuously and without interruption until the required depth of penetration and required blow count has been attained. Deviation from this procedure may be cause for rejection of the pile. A pile that cannot be driven to the required depth because of an obstruction, as indicated by a sudden unexplained change in blow count and/or drifting, shall be cut off, abandoned, and replaced. If the Contracting Officer determines that the replacement was required through no fault of the Contractor, approval for payment for both piles will be made. After piles are driven, they shall be cut off square to the finished groundline at the indicated cutoff elevation. The piles shall be marked prior to cutoff in such a manner that a legible footage mark remains after cutoff. Also, each pile shall have its designation clearly and visibly marked. Any voids developed around the piles as a result of driving shall be backfilled with dry, powdered bentonite and rodded to completely fill the void to the ground surface elevation. Field hydration of the bentonite is not required.

3.3.5.1 Splicing Piles

Full length piles must be used. Only a pile that has not reached the required blow count when the pile has been driven to grade may be spliced and driven to a sufficient depth to develop the required blow count. Piles with more than one splice will not be permitted. A complete penetration groove-weld splice shall be used per AWS-D.1.1. The H-pile splice shall be

capable of developing the equivalent yield strength and modulus of elasticity of the unspliced pile cross-section in bending, compression, and tension. Ends of the piles to be spliced shall be square so that full contact can be made between the abutting piles. Squaring, when required, shall be done by saw cutting or flame cutting with a strait edge. Field welding materials and workmanship for all piling shall conform to AWS-D1.1. All welders shall be certified as specified in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.3.5.2 Heaved Piles

When driving piles, measurements shall be accomplished by the Contractor to detect heave of adjacent piles. If heave exceeds 1/4 inch, the affected pile(s) shall be back driven to original depth of penetration without additional cost to the Government.

3.3.5.3 Pile Cutoffs

Lengths of cutoffs will be determined by subtracting the actual length driven below cutoff elevation and the length indicated on the drawings or as directed. Fifty percent allowance will be made for cutoffs.

3.4 PILE TESTS

Pile driving tests and pile load tests shall be performed as specified herein or as directed by the Contracting Officer. The pile testing subcontractor shall perform all pile driving tests and pile load tests, and shall then develop the correlation between pile driving resistance, pile length, and pile capacity for the selected pile driving system. Pile driving tests shall be completed prior to driving load test piles. The results of these tests shall be used to determine the appropriate locations for the load testing. A report shall then be prepared recommending pile lengths and blow counts required to obtain the design capacities of the piles. The report must contain all of the data from the pile driving tests and pile load tests, all assumptions, calculations, and analyses. The Davisson Criteria shall be used to determine the ultimate capacities from the load test data. The report shall be submitted to the Contracting Officer for approval of the required blow counts and lengths of permanent piles required to achieve the specified design capacities for compression, tension, and lateral loads.

Changes in the approved pile driving system during or after completion of tests will not be allowed unless additional tests are performed as directed by the Contracting Officer to establish the correlation between driving resistance, length and pile capacity for the proposed changed system. For changes in the approved pile driving system proposed by the Contractor, required additional pile driving tests and pile load tests shall be performed at the Contractor's expense and no additional contract time will be allowed.

3.4.1 Test Piles

Test and reaction piles for compression, tension, and lateral load tests shall be of a length equal to the estimated design length of permanent piles to be installed in the load test area as indicated in paragraph, "LENGTHS OF PERMANENT PILES." Test and reaction piles utilized for load testing shall be vertically driven to the tolerances denoted in this specification section for production piles and shall be incorporated into the permanent work after completion of the testing program. Test piles

shall be driven with the same equipment specified in paragraph, "PILE DRIVING EQUIPMENT" and in the same manner specified in paragraph, "INSTALLATION," subparagraph, "PILE DRIVING." The driving record data shall be recorded for each test pile driven as specified in paragraph, "INSTALLATION," subparagraph, "PILE DRIVING RECORDS." Test piles will be paid for under the same unit prices as the production piling.

3.4.2 Pile Driving Tests

A minimum of one pile driving test shall be performed at each structure site. The exact location for pile drive tests will be chosen by the Contracting Officer. Pile drive testing may be combined with the installation of test and reaction piles to be used for static load testing.

3.4.3 Dynamic Pile Testing

The pile testing subcontractor shall provide and operate a PDA as manufactured by Pile Dynamics Inc., Warrensville Hts., Ohio, or approved equal, and utilize the CAPWAP software package to determine pile stresses, velocity of stress wave propagation, hammer energy transmitted to piles, acceleration, dynamic capacity prediction, and extent and location of pile damages during the driving of permanent and test piles. CAPWAP shall be used to perform analyses on all piles tested with the PDA. CAPWAP analyses shall be performed at the jobsite as soon as practicable after driving. The pile testing subcontractor shall provide personnel experienced in performing wave equation analyses, dynamic testing and CAPWAP analyses, and are fully qualified through education and experience in the interpretation of results. Equipment to obtain dynamic measurements, record, reduce and display data shall be furnished by the subcontractor and shall meet the requirement of ASTM D 4945:

- All cables, gages, accessories;
- 2 strain transducers; 2 accelerometers; and,
- Pile analyzer (equal to Pile dynamics, model GCPC or more recent).

The equipment shall be calibrated prior to any testing on the job and every month thereafter throughout the contract duration. Contractor shall furnish the power supply to the pile driving analyzer. Power supply shall consist of a regular power source (line power or portable generator) providing 1800 watts of 115 volt AC and frequency of 60 HZ. Direct current welders or non-constant power sources are not acceptable.

3.4.3.1 Test Piles

Dynamic testing shall be performed on each of the driving test piles, but only on compression test piles driven for load testing. Dynamic testing shall be performed during the full length of pile driving. Piles which are statically load tested shall be re-struck within 48 hours after completion of static load test to correlate static and dynamic test results. All driving test piles shall also be re-struck after 7 days to evaluate soil setup on the piles at each structure site. The hammer shall be warmed up prior to re-striking. Gages shall be checked during initial driving to insure that the gages are functioning properly. Re-striking shall consist of impacting the pile for 50 blows or until the pile penetrates an additional 3 inches, whichever occurs first. In the event the pile movement during re-strike is less than one-quarter inch after 20 blows, the re-strike test may be terminated.

3.4.3.2 Permanent Piles

Dynamic pile testing shall be performed on the minimum number of permanent production piles during the full length of initial driving to establish driving criteria, and the same number piles, during re-strike driving. Tested piles shall be as selected by the Contracting Officer over the duration of installation to establish driving criteria. An equitable adjustment will be made by the Contracting Officer for re-strike piles selected out of sequence.

3.4.3.3 Reports

A summary report of dynamic test results for test piles shall be prepared and submitted in accordance with the paragraph, "SUBMITTALS." The report shall discuss pile capacity obtained from dynamic testing as compared to static test results, and also include velocity of stress wave propagation, acceleration, evaluation of hammer and driving system performance, driving stress levels, transferred energy, variations in trends in the data, and pile integrity. A CAPWAP, or similar, analysis of the dynamic test data shall be performed on data obtained from the end of initial driving and the beginning of re-strike for all test piles or as directed. The analysis shall be used to predict pile capacity. Refined wave equation analyses incorporating the results of dynamic testing and analysis shall be included. For permanent piles, a field summary report shall be prepared and submitted in accordance with paragraph, "SUBMITTALS." The field summary report shall minimally contain energy transferred to the pile, calculated driving stresses, pile integrity, and estimated pile capacity at the time of testing. The report for the test piles and for permanent piles shall include the pile driving record as an attachment and shall address the items listed in section 7.1.5 DYNAMIC TESTING, of ASTM D 4945.

3.4.4 Pile Load Tests

Pile load tests shall be performed under the supervision of the pile testing subcontractor. At least one lateral static load test shall be performed at each structural site included in this project as indicated in paragraph, "LENGTHS OF PERMANENT PILES." Test pile minimum loading criteria shall be two-hundred percent (200%) of the minimum design capacities as presented in paragraph, "LENGTHS OF PERMANENT PILES" of this specification section. All test and reaction piles for load testing shall be driven vertically. The exact location of the tests shall be determined by the Contracting Officer after completion of the pile driving tests. Test piles shall be driven to a final blow count as directed by the Contracting Officer. All piles driven for the load test, excluding reaction piles, shall be monitored with the PDA. All test and reaction piles to be utilized in load testing shall be driven at least 30 days prior to testing. The loading equipment shall be of sufficient capacity to apply the maximum specified load in a safe manner. Loading of each test pile shall be started when directed by the Contracting Officer. The Contractor shall be responsible for the application of loads. The magnitude of applied loads shall be accurately determined and controlled using a calibrated load cell and readout device. The hydraulic gate shall be separately serviced and calibrated. The jack and the hydraulic gage shall then be calibrated as a unit. Load test piles indicated or directed to be driven in permanent locations may be incorporated into the work if, after satisfactory completion of load test, they are approved for inclusion in that work. Any pile load test not accomplished in accordance with this specification will be rejected and a new pile load test shall be conducted at the Contractor's sole expense. The pile testing subcontractor shall compile a report for each pile load test which shall include, as a minimum, all applicable

information required by the ASTM specified test. Compressive and tensile load tests may not be performed on the same pile. A telltale to the pile tip shall be installed on all compressive and tensile test piles. All test and reaction piles shall be incorporated into the permanent work at the completion of the pile testing program. The pile testing subcontractor shall develop and submit for approval a detailed pile load test plan which shall include drawings as appropriate and contain the following information:

a. Method of reacting static test loads;

b. Method of shading (from the sun) the test pile and measuring systems;

c. Method of supporting reference beams;

d. Method of attaching and supporting dial gages for measuring pile movements;

e. Method and rate of applying static test load to piles;

f. Method of setup of secondary measurement system (surveyor's level, wire-scale, mirror, laser beam, etc.);

g. Details of loading frame and reaction systems design, including design computations and fabrication details;

h. Calibration curves for the load cell and readout device;

i. Details of telltale installation; and,

j. Location with specific pile designations of load test piles.

Approval of the plan shall not relieve the Contractor of the responsibility for structural and operational adequacies of the testing system.

3.4.4.1 Compressive Load Test

The Contractor shall perform pile compressive load tests in accordance with ASTM D 1143 STANDARD TEST METHOD FOR PILES UNDER STATIC AXIAL COMPRESSIVE LOAD, as modified herein. The testing frame and measuring equipment shall be capable of applying a compressive load of 200% of the MINIMUM DESIGN COMPRESSIVE CAPACITY as indicated in paragraph, "Length of Permanent Piles" of this specification section. Loads shall be applied in accordance with paragraph 5.6 QUICK LOAD TEST of ASTM D 1143. Unloading shall be done with a minimum of 5 decrements.

3.4.4.2 Tensile Load Test

The Contractor shall perform pile tensile load tests in accordance with ASTM D 3689 STANDARD TEST METHOD FOR INDIVIDUAL PILES UNDER STATIC AXIAL TENSILE LOAD, as modified herein. The testing frame and measuring equipment shall be capable of applying a tensile load of 200% of the MINIMUM DESIGN TENSILE CAPACITY as indicated in paragraph, "Length of Permanent Piles" of this specification section. Loads shall be applied in accordance with paragraph 7.7 QUICK LOAD TEST of ASTM D 3689. Unloading shall be done with a minimum of 5 decrements.

3.4.4.3 Lateral Load Test

The Contractor shall perform pile lateral load tests in accordance with ASTM D 3966 STANDARD TEST METHOD FOR PILES UNDER LATERAL LOADS, as modified herein. Each lateral load test shall consist of jacking two piles apart with a hydraulic jack, with one pile serving as the reaction pile for the other. The test arrangement and measuring equipment shall be capable of applying a load of 200% of the MINIMUM DESIGN LATERAL CAPACITY as indicated in paragraph, "Lengths of Permanent Piles" of this specification section. The measuring devices shall allow the determination of deflection contribution of both the test and reaction pile separately. The loads shall be applied in accordance with paragraph 6.1 STANDARD LOADING PROCEDURES of ASTM D 3966. Required movement readings shall be made and recorded for each pile.

3.4.4.4 Additional Tests

If the number of tests are adjusted during pile installation, an equitable adjustment in contract price will be made as discussed in the Construction Clauses.

-- End of Section --

SECTION 02457

STEEL 16-INCH AND 24-INCH DIAMETER PIPE PILES
03/01

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

Section LEVEE CONSTRUCTION AND EARTHWORK

Section EXCAVATION, TRENCING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A252-98e1	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM A 370	(1997a) Mechanical Testing of Steel Products
ASTM A 706	(1993) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM D 1143	(1981; R 1994e1) Piles Under Static Axial Compressive Load
ASTM D 3689	(1990) Individual Piles Under Static Axial Tensile Load
ASTM D 3966	(1990) Piles Under Lateral Loads
ASTM D 4945	(1989) High Strain Dynamic Testing of Piles

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Pile Driving Equipment; GA-GL.

Descriptions of pile driving equipment shall be submitted for approval at least 30 days prior to commencement of work. The equipment submittal shall include results of the Contractor's WEAP analysis in support of the equipment's viability in meeting the requirements of this contract action as described in paragraph "PILE DRIVING EQUIPMENT" of this specification section.

Pile Testing Subcontractor; GA-EC.

The proposed pile testing subcontractor along with appropriate resumes shall be submitted for approval at least 30 days prior to commencement of work.

Pile Driving Records; GA-RE.

The proposed forms and database for compiling pile driving records shall be submitted for approval 30 days prior to commencement of work.

Delivery, Storage and Handling; GA-GL.

Delivery, storage and handling plans for piles shall be submitted for approval at least 30 days prior to delivery of piles to the job site.

Pile Tests; GA-GL.

A pile load test plan shall be submitted for approval at least 30 days prior to installing any test piles. Approval of the plan shall not relieve the Contractor of the responsibility for structural and operational adequacies of the testing system.

SD-04 Drawings

Pile Splices; GA-EC.

Detail drawings of pile splices must be submitted and approved 30 days prior to pile installation.

Pile Placement; GA-GL.

A pile placement plan shall be submitted for approval at least 30 days prior to delivery of piles to the job site.

SD-09 Reports

Field Tests and Inspections; FIO-GL.

A complete report on the load test, including, but not limited to, a description of the pile driving equipment, driving records for both test

piles and reaction piles, complete test data, analysis of test data, and recommended allowable design loads based on the load test results, within 7 days of completion of load test. The report shall be prepared by or under the direct supervision of a registered professional engineer experienced in pile load testing and load test analysis.

SD-13 Certificates

Materials; GA-GL.

Certified copies of mill test reports for structural steel prior to commencement of pile installations.

SD-09 Reports

Mill Inspection; GA-EC.

The Mill Inspection Report shall be submitted for approval 30 days prior to the manufacture of any pipe piles for this project.

Pile Driving Tests; GA-GL.

Pile driving test data shall be submitted for approval within 1 day after each test is completed.

Pile Driving Analyzer; GA-GL.

Pile driving analyzer data, including CAPWAP analyses, shall be submitted for approval within 1 day after each test is completed. This shall also include all raw data on floppy disc, as well as all field logs.

Pile Load Tests; GA-GL.

Four copies of the load test report for each pile tested shall be submitted within 1 day after the load test is completed. Fax copies to: Kansas City District, Local Protection Section, (816) 426-3690. Typed formal reports shall be submitted within 5 days after completion of all test piles at each structure location. The Load Test Report shall, at a minimum, contain all information listed herein plus as listed in paragraph 8 of ASTM D-1143 for compressive pile tests, paragraph 9 of ASTM D-3689 for tensile load tests, and paragraph 9 of ASTM D-3966 for lateral load tests.

SD-18 Records

Pile Driving Records; GA-GL.

Fully completed pile driving records shall be submitted daily.

1.4 DELIVERY, STORAGE, AND HANDLING

Delivery, storage and handling of materials shall conform to the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Plans for the delivery, storage and handling of piles shall be developed and submitted for approval. (Sentences Deleted)

1.4.1 Delivery and Storage

Piles shall be stacked during delivery and storage so that each pile is maintained in a straight position and is supported along its length, ends inclusive, per the approved submittal. Piles shall not be stacked more than 5 feet high unless approved by the Contracting Officer. Pile stacks shall be adequately secured such that stacks of pipe piles are unable to collapse through spreading of the base pile layer. Barriers to prevent spreading shall be firmly embedded into the ground or shall be attached into a solid unit via connecting rods or bars extending beneath the stacked piles.

1.4.2 Handling

Pick-up devices shall be of the type that clamp to both pile ends. Holes may be burned in the ends of piles above the cutoff location for lifting piles into the leads provided it does not lead to damage of the pile during driving. Piles shall not be dragged across the ground. The Contractor shall inspect piles for irregularities (dents, creases, etc.) and for damages before transporting them from the storage area to the driving area and immediately prior to placement in the driving leads. Piles displaying irregularities or damage will be rejected.

1.5 PERSONNEL

1.5.1 General

The Contractor shall engage the services of a specialized pile testing subcontractor to perform all aspects of the required pile testing program. This subcontractor must be specialized in the field of pile testing and shall have proven expertise to perform all pile testing specified. The use of an additional specialized subcontractor, under the direction of the pile testing subcontractor, to perform and evaluate the test using the PDA will be permitted.

1.5.2 Qualifications

The pile testing subcontractor shall provide a field engineer who shall be on site full time during the pile driving activities for the project. This field engineer shall, at a minimum, have a Bachelor of Science Degree in Civil Engineering with a minimum of three years experience devoted to the monitoring of foundation pile installations. The field engineer shall be experienced in the use of a PDA and in performing pile load tests. The field engineer shall be a Registered Professional Engineer. A second engineer with the same qualifications will be required if the operation is scheduled on a multi-shift basis or extends over multiple shifts. In addition, the pile testing subcontractor shall identify a pile testing supervisor who shall be a principal of the firm with at least ten years experience in geotechnical engineering, of which at least five years experience has been devoted to the design and testing of pile foundations for major construction projects. The Contractor shall submit the name of the proposed pile testing subcontractor within 10 days of the date of contract award. The Contractor shall, in his submittal, outline the experience of the subcontractor and name the proposed field engineer, the proposed supervisor, and shall provide detailed resumes for each. If an additional subcontractor is to be used for testing with the PDA, the

submittal shall name the firm and include resumes of all individuals who will be operating the equipment and performing the analysis of the data in full or part. If the subcontractor and individuals meet the Government's approval, the Contractor shall be so notified within 30 days after receipt of the qualifications.

1.5.3 Responsibility

The pile testing subcontractor shall be responsible for the performance of all pile testing specified herein. This includes the compressive, tensile, lateral, and pile driving tests. The pile testing subcontractor shall be responsible for performing or administering dynamic testing of piles. The pile testing subcontractor shall be responsible for preparation of all submittals related to pile testing and of reports showing the results of all tests performed. The reports shall include an analysis of the data and a presentation of conclusions.

PART 2 PRODUCTS

2.1 MATERIALS

Material orders, materials lists and materials shipping bills shall conform to the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.1.1 Steel

Steel for pipe piles shall be 45 ksi yield strength and shall conform to ASTM A 252.

2.1.2 Pipe Piles

Pipe piles shall be of circular cross-section, either 16-inches outside diameter with walls 0.375-inches in thickness (15.25-inches inside diameter) or 24-inches outside diameter with walls 0.500-inches in thickness (23.00-inches inside diameter) as indicated on the drawings, and shall have standard square ends unless otherwise directed. Lengths of piles shall be as determined by pile testing as herein specified.

2.2 FABRICATION

Fabrication shall conform to the requirements shown on the drawings and specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.2.1 Pile Splices

Detail drawings of pile splices shall be submitted for approval.

PART 3 EXECUTION

3.1 SITE PREPARATION

All pile driving sites included in this contract action shall be prepared by the Contractor per Specification Section, LEVEE CONSTRUCTION AND EARTHWORK and Section, EXCAVATION, TRENCING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES.

3.2 PILE DRIVING EQUIPMENT

The Contractor shall select the proposed pile driving equipment, including hammers and other required items, and shall submit complete descriptions of the proposed equipment for approval including all information listed in paragraph 3.2.1.1. of this specification section. The Contractor shall perform a wave equation analysis using the most current version of **W**ave **E**quation **A**nalysis for **P**iles (WEAP) program or other approved computer program, on the proposed driving system prior to submittal to substantiate equipment viability in meeting project requirements. The results of the analysis must be included in the pile driving equipment submittal. The pile driving system must be capable of developing the required maximum ultimate load without exceeding 10 blows per inch and 90% of the specified yield stress of the pile. The pile driving equipment must be capable of re-driving piles if there is an interruption during installation. The Contractor should be aware that there may be significant soil set-up if driving of a pile is not continuous. Final approval of the proposed equipment is subject to the satisfactory completion and approval of pile tests. Changes in the selected pile driving equipment will not be permitted by the Government after the equipment has been approved by the Contracting Officer except as specified herein. No additional contract time will be allowed for Contractor-proposed changes in the equipment.

3.2.1 Pile Driving Hammers

Pile driving hammers shall be of the impact type.

3.2.1.1 Impact Hammers

Impact hammers shall be steam, air, hydraulic, or diesel hammers of the single acting, double-acting, or differential acting type. The size or capacity of hammers shall be determined by the Contractor as specified in paragraph "Pile Driving Equipment." Hammers shall be capable of driving to 20 blows per inch. Boiler, compressor, or engine capacity shall be sufficient to operate hammers continuously at the full rated speed. Hammers shall be equipped with a gage to monitor hammer bounce chamber pressure for closed-top diesel hammers or pressure at the hammer supply line for air and steam hammers. This gage shall be operational during the driving of all piles, both test and production, and shall be mounted in an accessible location to allow safe monitoring by the Contractor and the Contracting Officer. Two spare operational bounce chamber read out units shall be available on site. Damaged or non-operating bounce chamber pressure gages shall be immediately replaced by the Contractor upon discovery. The Contractor shall provide bounce chamber pressure gage correction tables and charts for the type and length of hose to be used with the pressure gage to the Contracting Officer. The hammer must be clearly marked at all times to identify the magnitude of the rated stroke and manufacturer recommended position of the stroke. The Contractor shall arrange for a representative of the hammer manufacturer to visit the site during initial test pile driving to inspect and verify that the hammer is

operating to the manufacturers specifications. The manufacturer's representative shall provide a letter report of his findings to the Contracting Officer. The Contractor shall submit the following information for each impact hammer proposed:

a. Make and model.

b. Ram weight (pounds).

c. Anvil weight (pounds).

d. Rated stroke and range of stroke for variable stroke hammers (inches).

e. Rated energy range (foot-pounds).

f. Rated speed (blows per minute), chart of speed vs. stroke for open-top diesel hammers.

g. Steam or air pressure, hammer, and boiler and/or compressor (pounds per square inch).

h. Rated energy vs. bounce chamber pressure curves or charts, including pressure correction chart for type and length of hose used with pressure gage (pounds per square inch).

i. Pile driving cap, make, dimensions, and weight (pounds).

j. Cushion block dimensions and material type, modulus of elasticity, coefficient of restitution, and supporting test data.

k. Power pack description and specifications

l. Hammer Operation Manual

m. Hammer Maintenance/Parts Manual

n. Identify any modifications that have been made to the hammer that make it different from the manufacturers standard

3.2.2 Pile Driving Leads

Hammers shall be supported and guided with fixed leads supported at a minimum of 2 points during driving. (Sentence Deleted) The leads shall be longer than the pile being driven.

3.2.3 Jetting

Jetting of piles is not permitted.

3.3 INSTALLATION

3.3.1 Lengths of Permanent Piles

The estimated quantities of piles listed in the unit price schedule are

given for bidding purposes only. After completion of pile load testing and pile driving testing, the Contractor shall evaluate the results and submit a schedule showing the proposed lengths of piles. The proposed length shall be measured from estimated tip to cutoff elevation plus an additional five feet. All piles shall be driven to the minimum embedment (possess the minimum length) as determined by loads testing and have the minimum design capacities as listed in the table below.

Monolith	Pile Rows	Design Number of Piles	Design Pile Diameter (inches)	Estimated Design Embedment Length* (feet)	Minimum Design Compress. Capacity (kips)	Minimum Design Tensile Capacity (kips)	Minimum Design Lateral Capacity (kips)	Load Tests Req'd
(M2)	1	15	16	25	44	8	22	---
	2	15	16	30	44	---	22	---
(M9B)	1	3	24	35	165	75	35	CTL
	2	3	24	35	---	---	---	---
	3	3	24	35	---	---	---	---

C - Compressive Load Test Required
T - Tension Test Required
L - Lateral Load Test Required

* To be determined by pile load testing as herein specified.

The Contractor shall base his bid on the assumption that the driving criteria for all piles is that required to obtain design compressive and tensile capacities as listed in the above table. The proposed lengths shall be submitted for individual monoliths after all load tests are complete and the driving tests are completed. The piles may not be ordered until the lengths of permanent piles have been approved by the Contracting Officer.

3.3.2 Pile Driving Records

The Contractor shall develop a form for compiling pile driving records which must be approved by the Contracting Officer. Complete and accurate records of the pile driving operations shall be compiled on the approved forms and submitted daily. Driving records for each pile shall include: date driven; name of inspector; pile identification number and location; pile dimensions; furnished length and driven length; ground elevation, final tip elevation, and final cutoff pile length; rig number; description of hammer used; recommended and actual blow rate; recommended and actual stroke; indication of stroke position; required and actual boiler, compressor, or bounce chamber pressure; number of blows required for each foot of penetration throughout the entire length of the pile and for each inch of penetration in the last foot of penetration; final rate of penetration; time of the start and finish of driving and total driving time in minutes and seconds; and, any other pertinent information as required or requested by the Contracting Officer such as unusual driving conditions, interruptions or delays during driving, damage to pile resulting from driving, heave in adjacent piles, splice location, length of additional splice pile, depth of additional driving, and depth and description of voids formed adjacent to the pile. All information for each pile shall be put on a one page record. Each pile shall have a separate record. A summary report shall also be prepared for each shift for each rig. The

report shall summarize important information for every pile driven by that rig during a shift. The report shall contain, as a minimum: the date, rig number, hammer identification, inspectors name, time of day, pile identification, furnished pile length, boiler, compressor, or bounce chamber pressure, hammer speed, final penetration rate, penetrated length, ground elevation, cutoff length, note any interruptions, delays, damage, rejections, down time, or any other pertinent information. The Contractor shall also develop a computer database using PC-compatible software in which all of the information from the daily driving records are entered on a daily basis. An updated database shall be furnished to the Contracting Officer on a weekly basis.

3.3.3 Pile Placement

A pile placement plan which shows the installation sequence and the methods proposed for controlling the location and alignment of piles shall be developed and submitted for approval. The plan shall identify each pile with a unique designation. Foundation preparation shall be completed according to Section, LEVEE CONSTRUCTION AND EARTHWORK and Section, EXCAVATION, TRENCING, AND BACKFILLING FOR UTILITIES SYSTEMS AND STRUCTURES prior to the placement of piles for driving. Piles shall be placed accurately in the correct location and alignments, both laterally and longitudinally, and to the vertical lines indicated. The Contractor shall establish a permanent base line to provide for inspection of pile placement by the Contracting Officer during pile driving operations. The base line shall be established prior to driving permanent piles and shall be maintained during the installation of the permanent piles. A stake shall be placed at the location of each pile with the pile designation clearly marked. A final lateral deviation from the correct location at the cutoff elevation of not more than 3 inches will be permitted for piles. A final variation in alignment of not more then 1/4 inch per foot of longitudinal axis will be permitted. A vertical deviation from the correct cut off elevations shown on the drawing of not more than 0-inches above to 2-inches below will be permitted. The correct relative position of all piles shall be maintained. Piles not located properly or exceeding the maximum limits for lateral deviation and/or variation in alignment shall be rejected and no payment will be made for this pile. Replacements for such rejected piles will be driven by the Contractor at locations directed by the Contracting Officer.

3.3.4 Pile Penetration Criteria

The piles shall be driven to at least the minimum embedment as determined from the pile load testing program and to the required final blow count as determined from the dynamic testing program. It is the responsibility of the Contractor to provide a pile driving system that will efficiently drive the piles to the required depth and blow count. The controlling depth of penetration and blow count (number of blows required to attain the final inch of penetration) for permanent piles will be determined subsequent to the analysis of pile tests as specified in paragraph, "PILE TESTS." If a pile reaches the required final blow count prior to the minimum penetration depth, driving of the pile shall continue until the pile is driven to refusal (20 blows per inch for 3 inches) or to the minimum specified embedment, whichever first occurs. The Contracting Officer must approve any pile that does not have minimum penetration for inclusion in the permanent work. Any pile that has been driven to grade without reaching the required blow count shall be spliced and driven until the required blow count is obtained. The Contractor should be aware that re-driving of piles after any interruption may be difficult due to the potential for soil

setup.

3.3.5 Pile Driving

The Contracting Officer shall be notified 30 days prior to the date pile driving is to begin. Piles shall not be driven within 100 feet of concrete less than 7 days old unless otherwise authorized. Permanent and test piles shall be driven with hammers of the same model and manufacturer, same energy and efficiency, and using the same driving system. Hammers shall be operated at the speed and under the conditions recommended by the manufacturer subject to the approval of the Contracting Officer. All piles shall be clearly marked in 1 foot increments with 1 inch increments within 5 feet of the design tip elevation, prior to driving. Where heave is anticipated, the sequence of installation shall be such that pile heave is minimized. Prior to driving and with the pile top seated in the drive head, each pile shall be checked to ensure that it has been aligned correctly. Once pile driving has begun, pile alignment shall be kept constant. Each pile shall be driven continuously and without interruption until the required depth of penetration and required blow count has been attained. Deviation from this procedure may be cause for rejection of the pile. A pile that cannot be driven to the required depth because of an obstruction, as indicated by a sudden unexplained change in blow count and/or drifting, shall be cut off, abandoned, and replaced. If the Contracting Officer determines that the replacement was required through no fault of the Contractor, approval for payment for both piles will be made. After piles are driven, they shall be cut off square to the finished groundline at the indicated cutoff elevation. The piles shall be marked prior to cutoff in such a manner that a legible footage mark remains after cutoff. Also, each pile shall have its designation clearly and visibly marked. Any voids developed around the piles as a result of driving shall be backfilled with dry, powdered bentonite and rodded to completely fill the void to the ground surface. Field hydration of the bentonite is not required.

3.3.5.1 Splicing Piles

Full length piles must be used. Only a pile that has not reached the required blow count when the pile has been driven to grade may be spliced and driven to a sufficient depth to develop the required blow count. Piles with more than one splice will not be permitted. A complete penetration groove-weld splice shall be used per AWS-D.1.1. The pipe pile splice shall be capable of developing the equivalent yield strength and modulus of elasticity of the unspliced pile cross-section in bending, compression, and tension. Ends of the piles to be spliced shall be square so that full contact can be made between the abutting piles. Squaring, when required, shall be done by saw cutting or flame cutting with a strait edge. Field welding materials and workmanship for all piling shall conform to AWS.D1.1. All welders shall be certified as specified in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.3.5.2 Heaved Piles

When driving piles, measurements shall be accomplished by the Contractor to detect heave of adjacent piles. If heave exceeds 1/4 inch, the affected pile(s) shall be back driven to original depth of penetration without additional cost to the Government.

3.3.5.3 Pile Cutoffs

Lengths of cutoffs will be determined by subtracting the actual length driven below the cutoff elevation and the length indicated on the drawings or as directed. Fifty percent allowance will be made for cutoffs.

3.4 PILE TESTS

Pile driving tests and pile load tests shall be performed as specified herein or as directed by the Contracting Officer. The pile testing subcontractor shall perform all pile driving tests and pile load tests, and shall then develop the correlation between pile driving resistance, pile length, and pile capacity for the selected pile driving system. Pile driving tests shall be completed prior to driving load test piles. The results of these tests shall be used to determine the appropriate locations for the load testing. A report shall then be prepared recommending pile lengths and blow counts required to obtain the design capacities of the piles. The report must contain all of the data from the pile driving tests and pile load tests, all assumptions, calculations, and analyses. The Davisson Criteria shall be used to determine the ultimate capacities from the load test data. The report must be submitted to the Contracting Officer for approval of determination of required blow counts and pile length of permanent piles to achieve the specified design capacities for compression, tension, and lateral loads.

Changes in the approved pile driving system during or after completion of tests will not be allowed unless additional tests are performed as directed by the Contracting Officer to establish the correlation between driving resistance, length and pile capacity for the proposed changed system. For changes in the approved pile driving system proposed by the Contractor, required additional pile driving tests and pile load tests shall be performed at the Contractor's expense and no additional contract time will be allowed.

3.4.1 Test Piles

Test and reaction piles for compression, tension, and lateral load tests shall be of a length equal to the estimated design length of permanent piles to be installed in the load test area as indicated in paragraph "LENGTHS OF PERMANENT PILES." Test and reaction piles utilized for load testing shall be vertically driven to the tolerances denoted in this specification section for production piles and shall be incorporated into the permanent work after completion of the testing program. Test piles shall be driven with the same equipment specified in paragraph "PILE DRIVING EQUIPMENT" and in the same manner specified in paragraph "INSTALLATION," subparagraph "PILE DRIVING." The driving record data shall be recorded for each test pile driven as specified in paragraph "INSTALLATION," subparagraph "PILE DRIVING RECORDS." Test piles will be paid for under the same unit prices as the production piling.

3.4.2 Pile Driving Tests

A minimum of one pile driving test shall be performed at each structure site. The exact location for pile drive tests will be chosen by the Contracting Officer.

3.4.3 Dynamic Pile Testing

The pile testing subcontractor shall provide and operate a PDA as manufactured by Pile Dynamics Inc., Warrensville Hts., Ohio, or approved equal, and utilize the CAPWAP software package to determine pile stresses, velocity of stress wave propagation, hammer energy transmitted to piles, acceleration, dynamic capacity prediction, and extent and location of pile damages during the driving of permanent and test piles. CAPWAP shall be used to perform analyses on all piles tested with the PDA. CAPWAP analyses shall be performed at the jobsite as soon as practicable after driving. The pile testing subcontractor shall provide personnel experienced in performing wave equation analyses, dynamic testing and CAPWAP analyses, and are fully qualified through education and experience in the interpretation of results. Equipment to obtain dynamic measurements, record, reduce and display data shall be furnished by the subcontractor and shall meet the requirement of ASTM D 4945;

· All cables, gages, accessories;
· 2 strain transducers, 2 accelerometers; and,
· Pile Driving Analyzer ([PDA] equal to Pile Dynamics model GCPA or most current model).

The equipment shall be calibrated prior to any testing on the job and every month thereafter throughout the contract duration. The Contractor shall furnish the power supply for the PDA. Power supply shall consist of a regular power source (line power or portable generator) providing 1800 watts of 115 volt AC at a frequency of 60 HZ or as directed by the PDA manufacturer.

3.4.3.1 Test Piles

Dynamic testing shall be performed on each of the driving test piles, but only on compression test piles driven for load testing. Dynamic testing shall be performed during the full length of test pile driving. Piles which are statically load tested shall be re-struck within 48 hours after completion of static load test to correlate static and dynamic test results. All driving test piles shall also be re-struck after 7 days to evaluate soil setup on the piles at each structure site. The hammer shall be warmed up prior to re-striking. Re-striking shall consist of impacting the pile for 50 blows or until the pile penetrates an additional 3 inches, whichever occurs first. In the event the pile movement during re-strike is less than one-quarter inch after 20 blows, the re-strike test may be terminated.

3.4.3.2 Permanent Piles

Dynamic pile testing shall be performed on the minimum number of permanent production piles during the full length of initial driving to establish driving criteria, and the same number of piles during re-strike driving. Tested piles shall be as selected by the Contracting Officer over the duration of installation to establish driving criteria. An equitable adjustment will be made by the Contracting Officer for re-strike piles selected out of sequence.

3.4.3.3 Reports

A summary report of dynamic test results for test piles shall be prepared

and submitted in accordance with the paragraph "SUBMITTALS." The report shall discuss pile capacity obtained from dynamic testing as compared to static test results, and also include velocity of stress wave propagation, acceleration, evaluation of hammer and driving system performance, driving stress levels, and pile integrity. A CAPWAP, or similar, analysis of the dynamic test data shall be performed on data obtained from the end of initial driving and the beginning of re-strike for all test piles or as directed. The analysis shall be used to predict pile capacity. Refined wave equation analyses incorporating the results of dynamic testing and analysis shall be included. For permanent piles, a field summary report shall be prepared and submitted in accordance with paragraph "SUBMITTALS." The field summary report shall minimally contain energy transferred to the pile, calculated driving stresses, pile integrity, and estimated pile capacity at the time of testing. The report for the test piles and for permanent piles shall include the pile driving record as an attachment and shall address the items listed in paragraph 7.1.5, Dynamic Testing, of ASTM D 4945.

3.4.4 Pile Load Tests

Pile load tests shall be performed under the supervision of the pile testing subcontractor. At least one each compressive, tensile, and lateral static load test shall be performed at each structural site included in this project as indicated in paragraph 3.3.1 LENGTHS OF PERMANENT PILES. Test pile minimum loading criteria shall be two-hundred percent (200%) of the minimum design capacities as presented in paragraph "LENGTHS OF PERMANENT PILES" of this specification section. All test and reaction piles for load testing shall be driven vertically. The exact location of the tests shall be determined by the Contracting Officer after completion of the pile driving tests. Test piles shall be driven to a final blow count as directed by the Contracting Officer. All piles driven for the load test, excluding reaction piles, shall be monitored with the PDA. All test and reaction piles to be utilized in load testing shall be driven at least 30 days prior to testing. The loading equipment shall be of sufficient capacity to apply the maximum specified load in a safe manner. Loading of each test pile shall be started when directed by the Contracting Officer. The Contractor shall be responsible for the application of loads. The magnitude of applied loads shall be accurately determined and controlled using a calibrated load cell and readout device. The hydraulic gate shall be separately serviced and calibrated. The jack and the hydraulic gage shall then be calibrated as a unit. Load test piles indicated or directed to be driven in permanent locations may be incorporated into the work if, after satisfactory completion of load test, they are approved for inclusion in that work. Any pile load test not accomplished in accordance with this specification will be rejected and a new pile load test shall be conducted at the Contractor's sole expense. The pile testing subcontractor shall compile a report for each pile load test which shall include, as a minimum, all applicable information required by the ASTM specified test. Compressive and tensile load tests may not be performed on the same pile. A telltale to the pile tip shall be installed on all compressive and tensile test piles. All test and reaction piles shall be incorporated into the permanent work at the completion of the pile testing program. The pile testing subcontractor shall develop and submit for approval a detailed pile load test plan which shall include drawings as appropriate and contain the following information:

a. Method of reacting static test loads;

b. Method of shading (from the sun) the test pile and measuring

systems;

c. Method of supporting reference beams;

d. Method of attaching and supporting dial gages for measuring pile movements;

e. Method and rate of applying static test load to piles;

f. Method of setup of secondary measurement system (surveyor's level, wire-scale, mirror, laser beam, etc.);

g. Details of loading frame and reaction systems design, including design computations and fabrication details;

h. Calibration curves for the load cell and readout device;

i. Details of telltale installation; and,

j. Location with specific pile designations of load test piles.

Approval of the plan shall not relieve the Contractor of the responsibility for structural and operational adequacies of the testing system.

3.4.4.1 Compressive Load Test

The Contractor shall perform pile compressive load tests in accordance with ASTM D 1143 STANDARD TEST METHOD FOR PILES UNDER STATIC AXIAL COMPRESSIVE LOAD, as modified herein. The testing frame and measuring equipment shall be capable of applying a compressive load of 200% of the MINIMUM DESIGN COMPRESSIVE CAPACITY as indicated in paragraph "Lengths of Permanent Piles" of this specification section. Loads shall be applied in accordance with paragraph 5.6 QUICK LOAD TEST of ASTM D 1143. Unloading shall be done with a minimum of 5 decrements.

3.4.4.2 Tensile Load Test

The Contractor shall perform pile tensile load tests in accordance with ASTM D 3689 STANDARD TEST METHOD FOR INDIVIDUAL PILES UNDER STATIC AXIAL TENSILE LOAD, as modified herein. The testing frame and measuring equipment shall be capable of applying a tensile load of 200% of the MINIMUM DESIGN TENSILE CAPACITY as indicated in paragraph "Lengths of Permanent Piles" of this specification section. Loads shall be applied in accordance with paragraph 7.7 QUICK LOAD TEST of ASTM D 3689. Unloading shall be done with a minimum of 5 decrements.

3.4.4.3 Lateral Load Test

The Contractor shall perform pile lateral load tests in accordance with ASTM D 3966 STANDARD TEST METHOD FOR PILES UNDER LATERAL LOAD. Each lateral load test shall consist of jacking two piles apart with a hydraulic jack, with one pile serving as the reaction pile for the other. The test arrangement and measuring equipment shall be capable of applying a load of 200% of the MINIMUM DESIGN LATERAL CAPACITY as indicated in paragraph "Lengths of Permanent Piles" of this specification section . The measuring devices shall allow the determination of deflection contribution of both the test and reaction pile separately. The loads shall be applied in accordance with paragraph 6.1 STANDARD LOADING PROCEDURES of ASTM D 3966. Required movement readings shall be made and recorded for each pile.

3.4.4.4 Additional Tests

If the number of tests are adjusted during pile installation, an equitable adjustment in contract price will be made as discussed in the Construction Clauses.

-- End of Section --

SECTION 02464

METAL SHEET PILING
05/92

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1995b) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 328/A 328M	(1993a) Steel Sheet Piling
ASTM A 572/A 572M	(1994c) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 690/A 690M	(1994) High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
ASTM A 857/A 857M	(1993a) Steel Sheet Piling, Cold Formed, Light Gage
ASTM B 221	(1995a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 221M	(1995a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)
ASTM B 308/B 308M	(1995a) Aluminum-Alloy 6061-T6 Standard Structural Shapes
ASTM A992/A992M	(1998) Steel for Structural Shapes for Use in Building Framing

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(1996) Structural Welding Code - Steel

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL

PROCEDURES:

SD-01 Data

Layout, Design Drawings, and Calculations; GA-RE

Signed and sealed layout, design drawings and calculations for an excavation support system and other data prepared by, or under the supervision of, a qualified Professional Engineer registered in the State of Missouri. System design and calculations must be acceptable to local authorities having jurisdiction. Information shall be submitted 30 days prior to construction.

A Professional Engineer registered in the State of Missouri, legally authorized to practice in the jurisdiction where the project is located, and experienced in providing successful engineering services for systems similar in the extent required for this project is required.

SD-04 Drawings

Metal Sheet Piling; GA-RE.

Detail drawings for sheet piling including fabricated sections shall show complete piling dimensions and details, driving sequence and location of installed piling. Detail drawings shall include details and dimensions of templates and other temporary guide structures for installing piling. Detail drawings shall provide details of the method of handling piling to prevent permanent deflection, distortion or damage to piling interlocks.

APPURTENANT METAL MATERIALS; GA-RE.

SD-07 Schedules

Pile Driving Equipment; GA-RE.

Complete descriptions of sheet piling driving equipment including hammers, extractors, protection caps and other installation appurtenances shall be submitted for approval 30 days prior to commencement of work.

SD-08 Statements

Pulling and Redriving; GA-RE.

The proposed method of pulling sheet piling shall be submitted and approved prior to pulling any piling.

DELETED

Materials Tests; FIO-RE.

Certified materials tests reports showing that sheet piling and appurtenant metal materials meet the specified requirements shall be submitted for each shipment and identified with specific lots prior to installing materials. Material test reports shall meet the requirements of ASTM A 6/A 6M.

SD-13 Certificates

Welder Qualifications; GA-RE.

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

SD-18 Records

Driving; FIO-RE.

Records of the sheet piling driving operations shall be submitted after driving is completed. These records shall provide a system of identification which shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions and top and bottom elevations of installed piling.

1.3 DELIVERY, STORAGE AND HANDLING

Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the sheet piling as required by the referenced specifications. Sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Storage of sheet piling should also facilitate required inspection activities. Sheet piling over 80 feet in length shall be handled using a minimum of two pickup points.

1.4 QUALITY ASSURANCE

1.4.1 Engineer Qualifications

A Professional Engineer registered in the State of Missouri, legally authorized to practice in the jurisdiction where the project is located, and experienced in providing successful engineering services for excavation support systems similar in the extent required for this project is required.

1.4.2 Supervision

The Contractor shall engage and assign supervision of the excavation support system to a qualified Professional Engineer foundation consultant, registered in the State of Missouri.

The Contractor shall submit the name of the engaged consultant and qualifying technical experience to the Contracting Officer's Representative (COR).

1.4.3 Regulations

The Contractor shall comply with all codes and ordinances of the governing authorities having jurisdiction.

PART 2 PRODUCTS

2.1 METAL SHEET PILING

Layout, Design Drawings, and Calculations for fabrication systems which are designed by the Contractor for Metal sheet piling and APPURTENANT METAL MATERIALS shall be provided. Also Welder Qualifications for all welds.

Metal sheet piling shall be hot-rolled steel sections conforming to ASTM A 328/A 328M or 39 ksi unless otherwise noted, interlocked joint strength in

tension as shown. Cold-formed steel sections shall be formed from hot-rolled steel meeting the chemical and mechanical requirements of ASTM A 328/A 328M. The interlocks of sheet piling shall be free-sliding, provide a swing angle suitable for the intended installation but not less than 5 degrees when interlocked, and maintain continuous interlocking when installed. Sheet piling shall be full-length sections of the dimensions shown. Fabricated sections shall conform to the requirement and the piling manufacturer's recommendations for fabricated sections. Sheet piling shall be provided with standard pulling holes. Metalwork fabrication for sheet piling studs shall be as specified and in Section, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.2 APPURTENANT METAL MATERIALS

Metal plates, shapes, bolts, nuts, rivets and other appurtenant fabrication and installation materials shall conform to manufacturer's standards and to the requirements specified in the respective sheet piling standards and in Section, MISCELLANEOUS METAL MATERIALS, STANDARD ARTICLES, AND SHOP FABRICATED ITEMS.

2.3 Steel Wales

Steel Wales shall meet ASTM A 572/A 572M or ASTM A992/A992M requirements.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Requirements for material tests, workmanship and other measures for quality assurance shall be as specified and in Section, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.4.1 Materials Tests

Materials tests shall conform to the following requirements. Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the site. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations. Testing of sheet piling shall meet the requirements of ASTM A 6/A 6M.

2.4.2 Paragraph Deleted

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Pile Driving Equipment

Pile driving equipment shall conform to the following requirements.

3.1.1.1 Driving Hammers

Hammers shall be steam, air, or diesel drop, single-acting, double-acting, differential-acting type. The driving energy of the hammers shall be between 8,750 and 16,000 foot pounds as recommended by the manufacturer for the piling weights and subsurface materials to be encountered.

3.1.1.2 Jetting Equipment

Jetting equipment shall not be used.

3.1.2 Placing and Driving

3.1.2.1 Placing

Any excavation required within the area where sheet pilings are to be installed shall be completed prior to placing sheet pilings. Pilings shall be carefully located as shown. Pilings shall be placed plumb with out-of-plumbness not exceeding 1/8 inch per foot of length and true to line. Temporary wales, templates, master pilings or guide structures shall be provided to insure that the pilings are placed and driven to the correct alignment. At least two templates shall be used in placing each piling and the maximum spacing of templates shall not exceed 20 feet. Master pilings shall be used to maintain plumbness and proper configuration in placing cofferdam cells over 90 feet in height in water flowing at a velocity of more than four feet per second. Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.

3.1.2.2 Driving

Prior to driving pilings in water a horizontal line shall be painted on both sides of each piling at a fixed distance from the bottom so that it shall be visible above the water line after installation. This line shall indicate the profile of the bottom elevation of installed pilings and potential problem areas can be identified by abrupt changes in its elevation. Pilings shall be driven with the proper size hammer and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths. Driving hammers shall be maintained in proper alignment during driving operations by use of leads or guides attached to the hammer. A protecting cap shall be employed in driving when using impact hammers to prevent damage to the tops of pilings. Pilings damaged during driving or driven out of interlock shall be removed and replaced at the Contractor's expense. Pilings shall be driven without the aid of a water jet. Adequate precautions shall be taken to insure that pilings are driven plumb. If at any time the forward or leading edge of the piling wall is found to be out-of-plumb in the plane of the wall the piling being driven shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out-of-plumb leading edge or other approved corrective measures shall be taken to insure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling shall be 1/8 inch per foot of length. Pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling. If obstructions restrict driving a piling to the specified penetration the obstructions shall be removed or penetrated with a chisel beam. If the Contractor demonstrates that removal or penetration is impractical the Contractor shall make changes in the design alignment of the piling structure as directed to insure the adequacy and stability of the structure. Pilings shall be driven to depths shown and shall extend up to the elevation indicated for the top of pilings. Piling driven to rock shall be seated individually on the rock. A tolerance of 1/8 inches above the indicated top elevation will be permitted. Pilings shall not be driven within 100 feet of concrete less than 7 days old.

3.1.3 Cutting-Off and Splicing

Pilings driven to refusal or to the point where additional penetration cannot be attained and are extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed at no additional cost to the Government. If directed pilings shall be spliced as required to drive them to depths greater than shown and extend them up to the required top elevation. Pilings adjoining spliced pilings shall be full length unless otherwise approved. If splices are allowed in adjoining pilings the splices must be spaced at least fivefeet apart in elevation. Splicing of pilings shall be as indicated. Ends of pilings to be spliced shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. The tops of pilings excessively battered during driving shall be trimmed when directed at no cost to the Government. Piling cut-offs shall become the property of the Contractor and shall be removed from the site. The Contractor shall cut holes in pilings for bolts, rods, drains or utilities as shown or as directed. All cutting shall be done in a neat and workmanlike manner. A straight edge shall be used in cuts made by burning to avoid abrupt nicks. Bolt holes in steel piling shall be drilled or may be burned and reamed by approved methods which will not damage the surrounding metal. Holes other than bolt holes shall be reasonably smooth and the proper size for rods and other items to be inserted.

3.1.4 Inspection of Driven Piling

The Contractor shall inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at the Contractor's expense.

3.1.5 Pulling and Redriving

In the pulling and redriving of piles as directed, the Contractor shall pull selected pilings after driving to determine the condition of the underground portions of pilings. Any piling so pulled and found to be damaged to the extent that its usefulness in the structure is impaired shall be removed and replaced at the Contractor's expense. Pilings pulled and found to be in satisfactory condition shall be redriven when directed.

3.2 REMOVAL

The removal of sheet pilings shall consist of pulling, sorting, cleaning the interlocks, inventorying and storing previously installed sheet pilings as shown and directed.

3.2.1 Pulling

The method of pulling piling must be approved. Pulling holes shall be provided in pilings as required. Extractors shall be of suitable type and size. Care shall be exercised during pulling of pilings to avoid damaging piling interlocks and adjacent construction. If the Contracting Officer determines that adjacent permanent construction has been damaged during pulling the Contractor will be required to repair this construction at no

cost to the Government. Pilings shall be pulled one sheet at a time. Pilings fused together shall be separated prior to pulling unless the Contractor demonstrates to the satisfaction of the Contracting Officer that the pilings cannot be separated. Any voids left after pulling shall be grouted with cement/bentonite mix. The Contractor will not be paid for the removal of pilings damaged beyond structural use due to proper care not being exercised during pulling.

3.2.2 Sorting, Cleaning, Inventorying and Storing

Pulled pilings shall be sorted, cleaned, inventoried and stored by type into groups as:

a. Piling usable without reconditioning.

b. Piling requiring reconditioning.

c. Piling damaged beyond structural use.

-- End of Section --

SECTION 02465

AUGER-PLACED GROUT PILES
09/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 109/C 109M	(1995) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 150	(1996) Portland Cement
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 937	(1980; R 1991) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 939	(1994a) Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM D 1143	(1981; R 1994) Piles Under Static Axial Compressive Load
ASTM 3689	Soil Test Method for Individual Piles Under Static Axial Tensile Load
ASTM 3966	Standard Test Methods for Piles Under Lateral Loads

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only. When used, a designation following the "GA" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Grout Pump; GA . Materials; GA. Equipment; GA-RE

A description of the materials to be used and the proposed methods of operations; including grout pressure monitoring and methods and devices to be used and installed on installation equipment to ensure that vertical plumb and batter inclinations are within specification during auger-cast piling installation..

Piling Equipment; GA-GL.

Descriptions of pile excavation equipment shall be submitted for approval at least 30 days prior to commencement of work. The equipment submittal shall include detailed drawings of augers, drill rig details, and drill string handling and hoisting details.

SD-04 Drawings

Grout Piling; GA .

Drawings to demonstrate compliance of augering, mixing, and pumping equipment, and installation and installed piles with contract documents. Drawings shall include detail and erection details and reinforcement fabrication as specified.

SD-08 Statements

Grout Piling; GA-RE .

Evidence to the Contracting Officer that the Contractor has been engaged in the successful installation of auger-placed grout piles for at least 5 years, and with experience with the sizes of pilings required in this project in the variety of installation conditions anticipated at the sites of piling installation on this project.

Plan of Operations; GA-GL

Contractor shall describe in his plan of operations the proposed construction technique to be implemented for auger-cast piling installation; the proposed construction sequence; how pile orientation is to be monitored during construction and the Contractor's plan for addressing (mitigating) piles found to be out of tolerance after constructed; and, how the reinforcement will be placed and how it will remain in its proper position after completion of the installation for both

battered and unbattered piles. The Grout Pump and Piling Equipment Data submittals may form a part of the Plan of Operations or may be submitted separately. The Plan of Operations shall also contain the resume of the proposed Field Engineer. The plan shall be submitted no later than 30 days prior to the scheduled commensement of field construction activities.

SD-09 Reports

Grout specimens for Contractor Tests; GA-RE.

Provide test reports for grout specimens within three days of completion of test.

TEST PILES; GA-RE.

SD-14 Samples

Grout Specimens for Laboratory Tests; GA-RE .

Provide nine cubes per eight hour shift as directed by the Contracting Officer

SD-18, Records

Quality Control; GA.

A complete and accurate record of all auger-placed grout piles (both test piles and production piles) prepared by the Contractor's Field Engineer. The record shall indicate the pile location, diameter, length, elevation of tip and top of pile, the head of grout observed above the auger tip, and the quantity of grout actually pumped into each pile hole excluding waste grout, and the results of applicable grout strength testing. Quality Control records shall be prepared on a daily basis with copies provided daily to the Government's Quality Assurance Inspector. Any conditions encountered during pile installation outside of routine installation procedures shall be reported immediately to the Contracting Officer.

1.3 DESCRIPTION

Augered placed grout piles (auger cast piles)are formed by the rotation of a continuous flight hollow-shaft auger into the ground to the tip elevation established by the requirements specified elsewhere in this section. Grout is then injected through the auger shaft as the auger is being withdrawn in such a way as to exert removing pressure on the withdrawing earth-filled auger as well as lateral pressure on the soil surrounding the grout-filled pile hole.

1.4 SUBSURFACE DATA

Subsurface soil data logs are shown on the drawings. The subsurface investigation field logs and samples of material taken from subsurface investigations may be examined in the Corps of Engineers, Kansas City

District, Local Protection Section. For information contact Richard Bateman at (816) 983-3604.

1.5 GROUT PUMP

Grout pump shall be a positive displacement pump of an approved design. The pump discharge capacity shall be calibrated in strokes per cubic foot or revolutions per cubic foot by a method approved by the Contracting Officer. Oil or other rust inhibitors shall be removed from mixing drums and pressure grout pumps prior to mixing and pumping.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Grout

Grout shall consist of a mixture of portland cement, a pozzolanic material when approved, fluidifier, sand, and water proportioned and mixed to produce a grout capable of being pumped with both a strength of 3000 psi within 24 hours of placement and a strength of 4000 psi within 28 days of placement.

2.1.1.1 Portland Cement

Portland cement shall conform to ASTM C 150.

2.1.1.2 Pozzolan

Pozzolan shall be a fly ash or other approved pozzolanic material conforming to ASTM C 618.

2.1.1.3 Grout Fluidifier

Grout fluidifier shall conform to ASTM C 937, except that expansion shall not exceed 4 percent. The fluidifier shall be a compound possessing characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement mortar.

2.1.1.4 Water

Water shall be fresh, clean, and free from sewage, oil, acid, alkali, salts, or organic matter.

2.1.1.5 Fine Aggregate

Fine aggregate shall meet the requirements of ASTM C 33. The sand shall consist of hard, dense, durable, uncoated rock particles and be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, a washing method shall be used that will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable. The sand shall be well-graded

from fine to coarse, with fineness modulus between 1.30 and 3.40. The fineness modulus is defined as the total divided by 100 of the cumulative percentages retained on U.S. Standard Sieve Numbers 16, 30, 50, and 100.

2.1.1.6 Air Entraining Admixtures

Air entrainment additive shall be included to produce a mix with 4 to 6 percent total air. The air-entraining admixture shall conform to ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining admixture shall be in a solution of sutable viscosity for field use.

2.1.1.7 Retarder

A retarding admixture may be used if concrete is placed during periods of high temperatures exceeding 68 degrees Fahrenheit. Retarder shall meet the requirements of ASTM C 494, Type B, except that the 6-month and 1-year compressive strength tests are waived. The use of the admixture is at the option of the Contractor.

2.1.1.8 Water Reducer

A water-reducing admixture shall meet the requirements of ASTM C 494, Type A or D except that the 6-month and 1-year compressive tests are waived. The admixture may be added to the concrete mixture only when its use is approved or directed. Type I water-reducing high range admixtures and Type G water-reducing, high range and retarding admixtures meeting ASTM C 494 shall not be used.

2.1.2 Reinforcement

Materials, assembly, and placement of reinforcement shall conform to the requirements of Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS and Section, CONCRETE REINFORCEMENT.

PART 3 EXECUTION

3.1 PLACEMENT REQUIREMENTS

Experienced auguer cast pile personnel shall be present during pile installations. The Contractor shall provide a Field Engineer experienced in auger-cast pile installation and testing procedures who shall be on-site full time during auger-cast pile compressive testing and construction activities. The Field Engineer shall possess qualifications as defined in Specification Section STEEL H-PILES, paragraph "Qualifications." Auger shall be advanced at a continuous rate with special precautions taken when advancing the auger in wet sands. Proper measures shall be taken by the Contractor if necessary to prevent or minimize the removal of excess soil. The ground surface at each pile location at the time of augering and grouting shall be at least 12 inches higher than the required pile cut-off elevation, and the augered hole shall be completely filled with grout. All materials shall be fed to the mixer accurately measured by weight, except water that may be measured by volume. The order of placing the materials shall be as follows: (1) water, (2) fluidifier, and (3) other solids in

order of increasing particle size. Time of mixing shall not be less than 1 minute. Grout injection equipment shall be provided with a grout pressure gauge in clear view of the equipment operator. Rate of grout injection and rate of auger withdrawal from the soil shall be so coordinated as to maintain at all times a positive pressure on this gauge. Magnitude of this pressure and performance of other augering and grouting procedures, such as rate of augering, rate of grout injection, and control of grout return around the auger flight, are dependent on soil conditions and equipment capability and shall be at the option of the Contractor, subject to the review by the Contracting Officer. The auger hoisting equipment shall be capable of withdrawing the auger smoothly and at a constant rate. Each pile hole shall be drilled and filled with grout in an uninterrupted operation. If grout pumping is interupted for any reason, the Contractor shall reinsert the auger by drilling at least 5 feet below the tip of the auger when the interuption occurred, and then regrout. A grout head of at least 5 feet of grout on the auger flighting above the injection point or to the grout head developed during the installation of test piles, whichever is greater, shall be maintained during raising of the auger. Reinforcement shall be inserted in the hole after grout has been placed. Care shall be taken to ensure that the reinforcement is properly positioned in the hole after grout placement. Contractor shall describe in his Plan of Operations submittal how the reinforcement will be placed and how it will remain in its proper position after completion of the installation for both battered and unbattered piles. Driving or pushing the reinforcement into the grout by any means other than manual assistance will not be permitted. Steel which does not penetrate under its own weight or by manual assistance shall be removed and the pile redrilled and regrouted as directed by the Contracting Officer. Material excavated by augering shall be disposed of by the Contractor outside the limits of right-of-way unless otherwise directed. If the excavated material qualifies for a fill zone, the excavated material may be used in the applicable fill zone. No pile shall be left partially completed overnight but must be completely grouted and protected at the termination of each day's operation.

3.1.1 Auger Removal

Should it become necessary to remove an auger string from the drilled hole without pumping grout, the following remedies shall be required, as appropriate, at no cost to the Government:

a. If the auger is removed once without grouting, the pile shall be redrilled and extended an additional length equal to 50% of the design length.

b. If the auger is removed more than once at the same location, the remedy shall be determined by the Contracting Officer based on an evaluation of the resulting subsurface conditions.

c. If adjacent piles have not been installed, the length of adjacent piles shall be increased 25% of the design length.

d. If adjacent piles have been installed, the design capacity shall be decreased by 25% for the first non-grouted removal. If more than two such events occur, the situation shall be evaluated by the Contracting

Officer to determine the appropriate remedy.

3.2 GROUT VOLUME

The volume of grout per linear foot of pile shall not be less than 1.15 times the theoretical volume of the pile. All volume measurements shall be made in the presence of the Contracting Officer or his representative.

3.3 CASINGS

The Contractor may case the hole to install the piles. Equipment and procedure using the casing method shall be submitted for approval by the Contracting Officer in the Plan of Operations submittal.

3.4 FLOW CONE TEST

The quantity of water used shall produce a grout having a consistency of not less than 21 seconds when tested with a flow cone in accordance with ASTM C 939.

3.5 GROUT SPECIMENS FOR LABORATORY TESTS

Grout tests shall be conducted in accordance with ASTM C 109/C 109M in a laboratory, approved by the Contracting Officer. Test specimens shall be prepared by pouring grout into 2 by 2 by 2 inch cube molds. Not less than 9 cubes shall be cast during each 8-hour shift. Three cubes shall be tested at the end of 24 hours; 3 at 7 days; 3 at 28 days; and 3 at 90 days.

3.6 GROUT SPECIMENS FOR CONTRACTOR TESTS

Grout tests shall be conducted by the Contractor in accordance with ASTM C 31/C 31M and ASTM C 39. Test specimens of grout shall be prepared by pouring grout into 6 by 12 inch cylinder molds. All cylinder molds shall be field cured. Molds shall be provided with a top cover plate so designed as to restrain grout expansion and to permit escape of air and water. Not less than one set of cylinders shall be collected during the placing of each group of 15 piles or fraction thereof. One set shall consist of nine cylinders of which three cylinders shall be tested in 24 hours, three cylinders at 7 days, and three cylinders at 28 days. Any set of cylinders of which one or more cylinders test at 10 percent or more below the required strength shall be cause for rejection of the pile group.Rejected piles shall be replaced with another pile to be located as directed by the Contracting Officer.

3.7 TEST PILES

3.7.1 General

Test piles shall be of the type and shall be placed in the manner specified elsewhere in this section for all piling. The Government will use test pile and load test data in addition to test reports on soil samples to determine "calculated" pile tip elevations and for constructability. Test piles shall be located near the permanent foundation system but shall not be used as production piles. Test piles shall be placed to the tip

elevation used for establishing lengths of piles for bidding, except as otherwise directed by the Contracting Officer. The Contractor shall submit a plan for testing indicating the test pile location, elevation, test procedure, and schedule of test pile and production pile installation for the Contracting Officer's approval. Loading, testing, recording, and analysis of data shall be under the direct supervision of the Contractor's Field Engineer. The Contracting Officer shall be present to observe the load tests. The Contractor shall notify the Contracting Officer at least 3 days prior to start of load tests. The installation of production piles shall not proceed until a satisfactory load test has been performed. Test piles shall be load tested a minimum of 2 months prior to installing any production piles. Test loads shall not be applied to the piles until the grout has obtained a minimum strength of 4000 psi.

3.7.2 Load Test

One compressive load test shall be performed in accordance with ASTM D 1143, standard or quick method modified as follows: 1) the requirement for pre-test information shall be deleted, 2) a recent (within 6 months of use during the test pile) calibration of the test jack, pressure gauge, etc. will be accepted in lieu of a calibration performed immediately prior to the test unless a previous calibration of the equipment within the specified time limit is unavailable in which case, an on-site calibration shall be performed by the Contractor, 3) the optional requirement for incremental strain measurement shall be deleted. The Load testing shall be performed under the direct, full-time supervision of the Field Engineer.

3.7.3 Initial Pile Testing

After right-of-way has been staked, the Contractor shall complete the pile testing. Information on the test pile will be used to verify constructability and allow for any necessary adjustments early in the construction process.

3.7.4 Acceptance of Load Test Piles

The test pile shall be loaded in accordance with ASTM D 1143, paragraphs 5.1.1 DIRECT LOADING METHOD and 5.3 LOADING IN EXCESS OF STANDARD TEST LOAD to at least twice but not more than three times the design working load of C=90 kips unless failure occurs first. The test pile will be considered of adequate design and construction if no apparent distress in the pile is noted and twice the design load does not cause gross settlement to exceed 1-inch. Should the test pile be determined to have failed as the result of poor Contractor performance (poor installation, grout of insufficient strength, etc.), the pile shall be replaced by the Contractor and the test repeated at no cost to the Government.

3.7.5 Tolerances

Piles shall be located as shown on drawings or as otherwise directed by the Contracting Officer. Piles shall be installed from the ground surface existing after general excavation work has been completed. The maximum variation of the center of any pile from the required location shall be 3 inches at the ground surface. Vertical piles shall be plumb within 2

percent. Battered piles shall be installed to within 4 percent of the specified batter as determined by the angle from horizontal. Damaged piles shall be abandoned and additional piles shall be installed as directed. Piles mislocated or out of alignment beyond maximum tolerances as set forth in this specification section will be evaluated by the Contracting Officer and any remedial action required, including, but not limited to redesign of the cap or the installation of additional piles, shall be provided by the Contractor at no cost to the Government.

3.8 PROTECTION OF PILES

The sequence of pile installation shall be such that previously installed piles show no evidence of disturbance. This evidence would actually appear as a drop in the grout surface. The load applied to the soil by the drilling equipment shall be far enough away from the pile being drilled to avoid compressing or shearing of the soil which may in turn displace or squeeze-off the grout column. No piles shall be placed within a distance equal to 3 pile diameters of the initial pile within 24 hours.

-- End of Section --

SECTION 02466

DRILLED FOUNDATION CAISSONS (PIERS)
12/97

PART 1 GENERAL

This specification section deals with the installation of drilled piers for this contract action. In the following text, the terms drilled pier, drilled shaft, drilled caisson, and caisson are used synonymously.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1999a) Concrete Aggregates
ASTM C 150	(1999a) Portland Cement
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 311	(1997) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 494	(1999a) Chemical Admixtures for Concrete
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-13 Certificates

Caissons; GA-RE

A certified copy of the survey. Lines and levels shall be established and caisson centerline locations staked and maintained by a registered surveyor or engineer provided by the Contractor.

Qualifications; GA-GL

Qualifications of the foundation system Contractor shall show that he has been engaged in the successful installation of drilled foundation caissons for at least 5-years.

SD-08 Statements

Plan of Operation;GA-GL

A detailed Plan of Operations shall be submitted to the Contracting Officer and work shall not begin until the submittal has been approved. The submittal shall include, as a minimum, pre-drilling plans for determining the final depth of drilled pier excavation; acquisition, storage, and protection of drilled pier construction materials; details of equipment proposed for use in drilled pier site investigations and construction including details as to the rated torque and down-pressure of the excavation equipment; details of methods proposed for measurement of vertical plumbness of drilled piers during excavation; proposed mitigation procedures to address piers found to be out of plumb tolerances as specified herein; and, details of the proposed concrete mix, mixing procedures, and placement procedures during installation.

SD-18 Records

Drilled Pier Site Explorations;GA-G

Detailed drilling logs of bedrock shall be compiled and continuous cores of bedrock shall be collected by the Contractor into separate submittals; one for each pre-excavation site investigation boring. Each submittal shall include a boring log classifying overburden materials encountered according to the Unified Soils Classification System; the depth of changes in material type and/or density; the depth to the top of bedrock; and, a detailed log of bedrock characteristics. Bedrock

characteristics include, at a minimum: rock type; weathering characteristics; fracture/joint types, pattern, and spacing; descriptions of the fracture/joint surfaces and any infilling; the presence, thickness, and complete description of seams of minor materials (differing rock types); weak zones; elevations of rock boundaries to include rock types, density changes, weathering changes, fracture zones, mechanical fractures, and other significant variations/features. Bedrock samples shall be classified by the Contractor in the field according to the Geomechanics Classification system (Rock Mass Rating [RMR], Bieniawski (1973)). The RMR system is described in Section II, Chapter 4 and Appendix B of Engineering Manual EM 1110-1-2908, 1994, available on the internet at http://www.usace.army.mil/inet/usace-docs/eng-manuals/em.htm. The RMR shall be indicated on the logs as well as boundaries separating one RMR zone from adjacent RMR zones. Soil boundaries shall be indicated to plus or minus 0.25 feet; bedrock boundaries/features shall be indicated to an accuracy of 0.1 feet. Borings shall be logged by a geologist registered in the State of Missouri and advanced by a driller licensed in the State of Missouri. Bedrock shall be cored beginning at the top of rock and extending to the bottom of the boring in a continuous manner. The bottom of each boring shall extend to a minimum depth of 5-feet below the top of rock or to a depth of 5-feet into rock having sufficient quality to serve as the drilled pier foundation. The Contractor shall indicate on the boring log the recommended bottom of drilled pier excavation based on the exploratory drilling along with data supporting the recommendation. Core shall be placed into a box specifically manufactured for rock core storage. The core shall be marked by use of wooden divider blocks with the following information written on the blocks using indelible ink: core run designation, depth of the top and bottom of each run, drill date and time, and the locations and amount of core loss and reason for each loss. Core shall be placed into the box with the top in the upper left corner and increasing depths to the left and down. Each box shall be labeled on the outside cover and the inside cover with the boring name, the inspector's name, the date of boring initiation and completion, and depths of bedrock contained therein. Each submittal of boring logs and samples shall be made available to the Contracting Officer for inspection not later than 24 hours after completion of the boring. Photos shall be taken of each filled core box and saved by the Contractor for later inclusion in the Drilled Foundation Caissons records.

Drilled Foundation Caissons; GA-GL

Detailed records in an approved form, for each caisson, including:

a. All logs, photos of bedrock removed from the subsurface exploration program, and recommendations proposed from the subsurface exploration program;

b. Constructed shaft diameters, batters, and top and bottom elevations;

c. Casing description;

d. Water conditions;

e. Concrete type, mix proportions, strength, and volume;

f. Rock elevations;

g. Dates of excavation and concrete placement; and,

h. All other pertinent information.

Upon completion of caisson installation work, the Contractor shall provide a record of centerline locations based on the survey of the registered surveyor or engineer provided by the Contractor. In addition, corrective measures shall be similarly recorded. A complete tabulation of all records pertaining to approved caissons shall be delivered to the Contracting Officer.

1.3 QUALIFICATIONS

1.3.1 Specialty Subcontractor

The work shall be performed by a specialty subcontractor, having at least 5-years documented experience in the installation of the specified foundation system under similar subsurface conditions.

1.3.2 Welding

Detail and field welding shall be in accordance with AWS D1.1. Qualification of welding procedures, welders, and welding operators shall be in accordance with AWS D1.1, Section 5. Records of test results of welding procedures not prequalified and copies of records for each qualified welding operator, containing records on positions of welding and types of electrode qualifications, shall be kept by the Contractor and be available for examination by the Contracting Officer.

1.4 PROJECT/SITE CONDITIONS

1.4.1 Subsurface Data

Subsurface soil boring logs are shown on the drawings for information only. See drawing sheet C-10a for the geologic rock profile at the R-2 structure and Section, SPECIAL SCHEDULING of these specifications for additional requirements. Detailed field-developed boring logs are available for examination at the Kansas City District Office, Geotechnical Branch, Geology Section, POC Mr. Steve Jirousek at (816) 983-3681. The Contractor shall independently develop a detailed subsurface profile for the purpose of constructing drilled piers according to paragraph, "SUBMITTALS," subparagraph "Drilled Pier Site Explorations."

1.4.2 Caisson Drilling Equipment

Caisson drilling equipment shall have the minimum torque capacity and downward force capacity for the contract site conditions. Equipment determined by the Contracting Officer to be inadequate for contract site conditions shall be removed from the site and replaced with equipment able to meet contract specifications at the Contractor's sole expense. An equipment list shall be included by the Contractor in the Plan of Operations indicating the torque and downward force capacities of the proposed drilled shaft construction equipment. Shaft excavation equipment shall be equipped with a device that continuously monitors the plumbness and/or batter of the hole. This monitoring device shall be fully described in the Contractor's Plan of Operations as well as measures proposed to be taken by the Contractor in the event the hole being excavated falls outside the vertical and batter tolerance limits specified herein.

1.5 SEQUENCE OF WORK

1.5.1 Caisson Excavation

Excavation of caissons or groups of caissons shall be performed so that reinforcing steel and concrete placement is a continuous operation performed the same day that the excavation is completed. Excavations shall not be left open overnight.

1.5.2 Acceptance

Concrete shall be placed within 3 hours after approval of the completed excavation.

1.6 SUPERVISION, INSPECTION, AND SAFETY

1.6.1 Contractor Supervision

The Contractor shall provide for the supervision of all phases of drilled pier construction. Supervision shall be the Contractor's responsibility as outlined in Quality Control provisions of the SPECIAL CONTRACT REQUIREMENTS. Each drilled pier excavation shall be checked by the Contractor for its depth, water removal, cleanup, workmanship, and for all tolerance requirements before any concrete is placed.

1.6.2 Government Inspection

The Contracting Officer or his authorized representative may inspect each drilled pier excavation given conditions suitable for the safe entry of the inspector into the hole. Concrete shall not be placed until the excavation has been approved by the Contracting Officer. The Contractor shall provide the Contracting Officer notice of drilled pier construction 10 days prior to the beginning of drilled pier work activities. The Contractor shall furnish the Contracting Officer or his authorized representative all necessary equipment required for proper inspection of drilled pier excavations. In the event that entry into the excavation cannot be safely performed, the Contracting Officer or his authorized representative will inspect large diameter drill cores retrieved by the Contractor from the bottom of the excavation. Approval of the excavation will depend on the

condition and properties of the rock contained in the core sample.

1.6.3 Safety Precautions for Workmen and Inspectors

1.6.3.1 Life Line

Each person entering a drilled pier excavation shall be provided with a life line rigged so that the person can be immediately hoisted out of the excavation in an emergency. The life line shall be suitable for instant rescue, securely fastened to a shoulder harness, and separated from any line used to remove excavated materials. No person shall be lowered into a drilled pier excavation prior to casing the shaft through the overburden. Shaft casing shall be extended above the existing ground surface such that drill spoils or loose materials on the ground surface around the shaft entrance cannot inadvertently fall or be kicked into into the shaft by passing personnel or equipment. An observer positioned at the top of the hole shall be present at all times when any person is performing duties within the hole.

1.6.3.2 Ventilation

Each drilled pier excavation shall be provided with a ventilating device of sufficient capacity to assure a safe and healthy atmosphere before workmen and inspectors are permitted to enter the drilled pier excavation. The ventilating device shall remain during all work periods when workers/inspectors are performing duties within the hole.

1.6.3.3 Loose Materials or Drill Spoils

Casing shall be above grade elevation for all inspections to keep all Loose Materials or Drill Spoils from falling in.

PART 2 PRODUCTS

2.1 CONCRETE WORK

Concrete work shall be in accordance with requirements of Section, CAST-IN-PLACE STRUCTURAL CONCRETE, as modified herein:

2.1.1 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, size number 67 and shall not exceed 40 percent of the total aggregate weight.

2.1.2 Cement

Cement used in the manufacture of concrete for drilled piers shall conform to ASTM C 150, Type I or II, and shall be low alkali.

2.1.3 Cement Content

When cementitious material consists of cement only, the minimum cement content shall be 564 pounds per cubic yard. When a pozzolan is used, the cementitious material content shall be that necessary to meet the strength

requirements specified herein. The volume of pozzolan shall not exceed 25 percent of the solid volume of the cementitous material.

2.1.4 Strength

Concrete strength shall be 4000 psi at 28 days. Slump shall be from 6 to 8-inches.

2.1.5 ADMIXTURES

a. Air Entrainment Mixtures: The air-entraining admixture shall conform to ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining admixture shall be in a solution of suitable viscosity for field use.

b. Accelerators: Accelerators meeting the requirements of ASTM C 494, Type C or E, may be used as required only when their use is approved or directed.

c. Retarder: A retarding admixture shall meet the requirements of ASTM C 494, Type B, except that the 6-month and 1-year compressive strength tests are waived. The use of the admixture is at the option of the Contractor.

d. Water-Reducer: A water-reducing admixture shall meet the requirements of ASTM C 494, Type A or D, except that the 6-month and 1-year compressive strength tests are waived. The admixture may be added to the concrete mixture only when its use has been approved or directed. Type I water-reducing high-range admixtures and Type G water-reducing, high-range, and retarding admixtures meeting ASTM C 494 shall not be used.

e. Pozzolan: Pozzolan shall conform to ASTM C 618, Class C or F, including the Supplementary Optional Physical Requirement for available alkalis and the Supplemental Optional Physical Requirements for uniformity and reactivity with cement alkalis. Minimum loss on ignition shall not exceed 4 percent. Samples shall be obtained, prepared, and tested by the Contractor in accordance with ASTM C 311.

2.1.6 Reinforcing Steel

a. Reinforcing steel shall conform to ASTM A 615, Grade 60.

b. Steel shall be welded into cages in accordance with AWS D1.4 and inserted securely in the caissons, in position and alignment, as shown, prior to concrete placement.

c. Steel reinforcing cages shall be centered in the hole using either precast concrete wheels mounted on a smooth rebar or compatible axle tied to the reinforcing cage perpendicular to the axis of the pier or precast concrete vertical skids, tapered and rounded in the vertical direction , tied to the horizontal and vertical reinforcing steel. The rebar axle shall have the same clear distance from the surface of the concrete as the reinforcing steel. Tie wires cast in the vertical skid blocks shall be cast in the inner one third of the skid block. The Contractor may propose

other types of centering devices. Drawings showing other proposed centering devices shall be prepared by the Contractor and submitted to the Contracting Officer for review and approval. A minimum of three centering devices shall be approximately located at the third points (120 degree separation) around the perimeter of the shaft. A minimum of three levels of centering devices shall be used per cage (near the top, center, and bottom). Centering devices shall maintain the minimum specified clearance between the casing and sidewalls of the shaft and the reinforcing steel.

PART 3 EXECUTION

3.1 PREPARATION

a. Caissons shall be excavated to established depths and dimensions shown. Bottoms of caissons shall be cleaned of loose or soft material and uniformly leveled at right angles to the longitudinal axis of the shaft. Battered compression drilled piers and vertical tension drilled piers shall be founded a minimum of 2-feet and 5-feet, respectively, into sound, durable limestone without characteristics of solutioning, open joints, clay seams, fractures, and no discernable shale seams. Excavated material shall be disposed of in accordance with Section, LEVEE CONSTRUCTION AND EARTHWORK.

b. In drilling caissons, the surrounding soil and the earth walls shall be adequately and securely protected against cave-ins, displacement of the surrounding earth, and retention of ground water, by means of temporary steel casings for vertical caissons and permanent casings for battered piers. Casings shall have outside diameters not less than indicated shaft sizes, shall be a minimum of ¼-inch thick, and shall not be removed if the structural integrity of the caisson will be impaired, as determined by the Contracting Officer. Temporary steel casings shall be withdrawn, as the concrete is being placed, maintaining sufficient head of concrete within the casing to prevent extraneous material from falling in from the sides and mixing with the concrete. Casings may be jerked upward a maximum of 4-inches to break the bottom seal, but thereafter shall be removed with a smooth, continuous motion. Permanent casings shall remain in place and shall not be removed by the Contractor unless otherwise directed by the Contracting Officer.

c. The inside of steel casings shall be thoroughly cleaned and oiled before reuse.

d. The temporary casing shall be employed in the construction of vertical tension drilled piers. The temporary casing shall be in place extending from the caisson top to the bedrock surface until the concrete has set if the elevation of the top of the caisson is below the adjacent ground surface.

e. Permanent steel casings shall be employed in the construction of battered compression drilled piers. The permanent casing for

battered drilled piers shall be equipped with a cutting shoe and shall be rotated to firmly seat the full base of the casing into bedrock. After cleaning out the casing, a rock coring barrel shall be utilized to advance the hole to the final bearing depth. The core shall be returned to the ground surface for inspection by the Contracting Officer or his authorized representative.

f. In the event of a condition that renders it impracticable or impossible to dewater the excavation, concrete shall be placed using underwater tremie techniques after water movement has stabilized.

g. Each caisson excavation and/or the bottom rock core retrieved from each excavation will be inspected and approved by the Contracting Officer or his approved representative prior to placing concrete. A record of all inspections, with related construction changes, shall be kept by the Contractor and made available for review by the Contracting Officer upon request. The Contractor shall provide support personnel for inspection and testing procedures.

3.2 INSTALLATION

a. The drilled pier shall be advanced through overburden by standard excavation techniques as described and approved in the Contractor's Plan of Operations. All bedrock encountered in the excavation shall be excavated and removed by means of full-diameter rock coring methods. The rock core shall be brought to the surface as intact as is practicable and left near the excavation site for inspection by the Contracting Officer or his approved representative. Rock cores or portions thereof from adjacent borings shall not be mixed. Material from each boring shall be maintained independent of all other borings until approval is received from the Contracting Officer that the rock may be removed from the site.

b. Concrete shall be continuously placed by methods that ensure against segregation and dislodging of excavation sidewalls, and shall completely fill the shaft. Concrete shall be placed by pumping or drop chutes in dry holes and by tremie or pumping in wet holes. The discharge shall be kept a minimum of 3-feet below the fresh concrete surface during placement. Drilling of caissons or driving of casings shall not be within 20-feet of concrete placed within the last 3 days or having a verified minimum strength of less than 2000 psi. Subsurface construction activity within 20-feet of piers constructed less than 3-days earlier requires Contracting Officer approval.

c. Concrete shall be brought to a true level surface inside the shaft and a full width cross key formed, or dowels installed, should it become necessary to interrupt placing concrete in any caisson. Prior to placing additional concrete, surfaces shall be cleaned of laitance and slush with one-to-one portland cement grout. The grout shall have a water-cement ratio not exceeding that of the

concrete.

d. Concrete shall be vibrated for the full height of the caisson.

3.3 TOLERANCES

a. Any caisson out of center or plumb beyond the tolerance specified shall be corrected as necessary to comply with the tolerances and the Contractor shall bear any cost of correction.

b. Cross sections of shafts and bells shall not be less than design dimensions.

c. Caissons shall be installed with top location deviating a maximum of 2-inches from centerline locations.

d. Vertical caissons shall be installed plumb within a maximum of two (2) percent

e. Battered caissons shall be installed with deviations no greater than two (2) percent of the length from the specified batter.

3.4 PROTECTION

Protection shall be provided around top of the excavation to prevent debris from being dislodged into the excavation and concrete.

-- End of Section --

SECTION 02510

WATER DISTRIBUTION SYSTEM
04/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997ael) Carbon Structural Steel
ASTM A312	(2000) Seamless and Welded Austenitic Stainless Steel Pipe

ASME INTERNATIONAL (ASME)

ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 In. (1,400 mm through 1,600 mm) for Water Service
AWWA C200	(1997) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA C208	(1996) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C220	(1998)Stainless Steel Pipe - 4 inches and Larger
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C509	(1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C706	(1996) Direct-Reading, Remote-Registration Systems for Cold-Water Meters

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA Work Practices	(1988) Recommended Work Practices for A/C Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-01 (1993) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

NSF INTERNATIONAL (NSF)

NSF 61 (1999) Drinking Water System Components - Health Effects (Sections 1-9)

1.2 PIPING

This section covers water service lines as shown on the plans or as directed by the COR. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 3 inches in diameter shall be stainless steel. Piping for water service lines 3 inches and larger shall be ductile iron.

1.2.2 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.3 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only. When used, a designation following the "GA" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-06 Instructions

Installation; GA-RE.

The manufacturer's recommendations for each material or procedure to be utilized.

Product Literature; GA-RE.

Submit product literature that includes information on the performance and operation of the "Duckbill" Elastomeric Check Valve, materials of construction, dimensions and weights, elastomer characteristics, flow data, headloss data, and pressure ratings.

Upon request, provide shop drawings that clearly identify the valve dimensions.

SD-13 Certificates

Meters; GA-RE.

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

SD-08 Statements

Waste Water Disposal Method; GA-RE.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

SD-09 Reports

Bacteriological Disinfection; GA-RE.

Test results from commercial laboratory verifying disinfection.

1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government.

1.5 QUALITY ASSURANCE

Manufacturer shall provide references and a list of installations upon request.

Manufacturer shall have performed hydraulic tests on valves for flow capacity, headloss, and jet velocity at an accredited flow laboratory. Manufacturer shall provide test data upon request.

Upon request, manufacturer shall provide installation data for existing valves of similar size and type to the project scope.

1.6 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. Pipe shall be encased with polyethylene in accordance with AWWA C105 where indicated on the plans. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

2.1.2 Stainless Steel Pipe

Stainless Steel pipe shall conform to AWWA C220 with dimensional requirements as given in ASME B36.10M for pipe 4 inches in diameter and larger, and ASTM A312 for smaller sizes. Ends shall be in accordance with AWWA C606. Ends for sizes less than 6 inches diameter shall be as required by AWWA C200. Pipe shall be Schedule 80 Type 304 stainless steel with screwed or flanged fittings.

2.1.3 Ductile-Iron Pipe System

Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

2.1.4 Steel Pipe System

2.1.4.1 Stainless Steel Pipe

Fittings and specials shall be made of the same material as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Dimensions of steel pipe fittings shall be in accordance with AWWA C208. The thickness and pressure rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same material used for the pipe with the same number of applications of each material, smoothly applied.

2.1.5 Ductile-Iron Pipe Jointing

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA C111.

2.1.6 Steel Pipe Jointing

2.1.6.1 Stainless Steel Pipe

a. Mechanical couplings and screwed joints shall be as specified.

b. Flanges shall conform to AWWA C207, and shall be used only in above ground installation or where shown on the drawings, or when approved.

2.1.6.2 Mechanical Couplings

Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.1.7 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe

sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.2 VALVES

2.2.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

b. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

c. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

2.2.2 "Duckbill" Elastomeric Check Valves (Sparging Nozzles)

Diffuser Check Valves are to be all rubber of the flow operated check type with a slip-on connection. The Check Valve shall be designed to slip over a stainless steel nipple and attached by manufacturer with "Band-It" 304 stainless steel clamps or equal. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The valve shall be one piece rubber with nylon reinforcement.

2.2.2.1 Function

When line pressure inside the valve exceeds the back pressure outside the valve, the line pressure forces the bills of the valve to open, allowing flow to pass. When back pressure exceeds the line pressure, the bills of hte valve are forced closed.

2.2.2.2 Manufacturer

All valves shall be of the Series TF-2 as manufactured by the Red Valve Co., Inc. of Carnegie, PA 15106 or approved equal.

2.3 VALVE BOXES

Valve boxes shall be cast iron or plastic, except that plastic boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.3 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with Section, CAST-IN-PLACE STRUCTURAL CONCRETE.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies shall be tested, approved, and listed in accordance with FCCCHR-01. Reduced pressure principle backflow preventers shall conform to ASSE 1013.

2.6 MISCELLANEOUS ITEMS

2.3.1 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.3.2 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.3.3 Meters

Meters shall be the type and size shown on the drawings or specified. Meters of each of the various types furnished and installed shall be

supplied by one manufacturer.

2.3.4 Turbine Type

Turbine type meters shall conform to AWWA C701. The main casing shall be bronze with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.3.5 Meter Boxes

Meter boxes shall be of cast iron or concrete with cast iron lid and cast iron meter reader lid. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas

lines, fuel lines, or electric wiring.

3.1.2.3 Casing Pipe

Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, in all other cases, the pipe sleeve shall be steel, manufactured in accordance with AWWA C200, ASTM A 36/A 36M, with a minimum wall thickness of 0.25 in. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided.

3.1.2.4 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections

to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.2 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.3 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

3.1.5.1 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.2 Stainless Steel Pipe Requirements

a. Mechanical Couplings: Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

3.1.5.3 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.1.5.4 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines Larger than 2 Inches

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Lines 3 inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.1.7 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.7.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.7.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.1.8 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.8.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.8.3 Location of Valves

After delivery, valves shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the

valves. Boxes shall be installed over each outside gate valve unless otherwise shown.

3.1.8 "Duckbill" Elastomeric Check Valves (Sparging Nozzles)

Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

3.1.8.1 Manufacturer's Customer Service

Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 0.5 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the

hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 Bacteriological Disinfection

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory shall be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 02531

SANITARY SEWERS
05/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(1999) Manual for Railway Engineering (4 Vol.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 14	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1995) Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 33	(1993) Concrete Aggregates
ASTM C 76	(1998) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(1998) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 94	(1998) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 270	(1997ael) Mortar for Unit Masonry
ASTM C 425	(1998) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using

	Rubber Gaskets (Metric)
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(1997) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 828	(1998) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989; R 1997) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1999) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a)Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(1996) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(1996) Polyethylene Plastics Pipe and

Fittings Materials

ASTM D 3753	(1981; R 1991) Glass-Fiber-Reinforced Polyester Manholes
ASTM D 3840	(1988) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM D 4161	(1996)"Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(1997) Polyethylene (PE) Plastic pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1997) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1998) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(1996a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data

NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

All reinforced concrete sewer pipe shall meet the requirements of Section: STORM-DRAINAGE SYSTEM. The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-13 Certificates

Portland Cement; GA-RE.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Joints

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans as shown are oil resistant.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Ductile Iron Pipe

Pipe shall conform to AWWA C151 unless otherwise shown or specified.

2.1.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 15 inches or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8 inch through 48 inch diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 Fittings for Ductile Iron Pipe

Mechanical fittings shall conform to AWWA C110, rated for 150 psi. Push-on fittings shall conform to AWWA C110and AWWA C111, rated for 150 psi.

2.2.2 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

2.2.2.1 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil resistant.

2.3.1 Ductile Iron Pipe Jointing

Push-on joints shall conform to AWWA C111. Mechanical joints shall conform to AWWA C111 as modified by AWWA C151. Flanged joints shall conform to AWWA C115.

2.3.2 Plastic Pipe Jointing

Flexible plastic pipe (PVC or high density polyethylene pipe) gasketed joints shall conform to ASTM D 3212.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478 or ASTM C 478M. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.6 STEEL LADDER

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement

shall have a compressive strength of 2500 psiminimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.8 STRUCTURES

2.8.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

3.1.1.2 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.

e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Caulked Joints

The packing material shall be well packed into the annular space to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of 1 inch after caulking.

3.1.2.2 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.3 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.4 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.5 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.6 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 25 gal per inch diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe, but 95 percent for RPMP and RTRP. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of 70,000 psi or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to

1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, or 5 percent for RTRP and RPMP, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLE DETAILS

3.4.1 General Requirements

Manholes shall be constructed of glass-fiber-reinforced polyester, prefabricated plastic, concrete, or precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches.

3.4.2 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from

surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.4.3 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.4 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 2 inch adjusting rings. The bottom section shall be 12 inches in height. A 6 inch high top section will cover up to two, 2 inchadjusting rings. A 12 inch high bottom section will cover up to six, 2 inch adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 2 inches and shall be overlapped by the top section by 2 inches.

3.5 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the

drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

SECTION 02630

STORM-DRAINAGE SYSTEM
09/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges
AASHTO M 190	(1988) Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 198	(1994) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 243	(1994) Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 716	(1995) Ductile Iron Culvert Pipe
ASTM A 760/A 760M	(1997) Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM C 76	(1997) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 91	(1998) Masonry Cement
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(1997a) Mortar for Unit Masonry
ASTM C 361	(1999) Reinforced Concrete Low-Head Pressure Pipe

ASTM C 443	(1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 780	(1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 789	(1995a) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 850	(1995a) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 ft of Cover Subjected to Highway Loadings
ASTM C 877	(1994) External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 1072	(1994) Measurement of Masonry Flexural Bond Strength
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-06 Instructions

Placing Pipe; GA-RE.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-13 Certificates

Pipe Testing; GA-RE. Pipeline Testing; GA-RE. Hydrostatic Test on Watertight Joints; GA-RE. Determination of Density; GA-RE. Frame and Cover for Gratings; GA-RE.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed AASHTO H-20 live load

SD-14 Samples

Pipe for Culverts and Storm Drains; GA-RE.

Samples of the materials, before work is started: All Pipe for Culverts and Storm Drains samples shall be on site. All other samples shall be be sent as directed by the COR. Some samples may be included in the work if approved by the COR. For each RCP supplied the wall type, A,B or C, shall be furnished with the submittal.

Choice of Piping; GA-RE.

Where the materials of the pipe is not specified on the drawings, the Contractor must submit his choice of piping material to be used for each individual application to the Contracting Officer's Representative for written approval before proceeding.

JOINTS; GA-RE

Where the materials of the pipe joints are not specified on the drawings, the Contractor must submit his choice of piping joints material to be used for each individual application to the Contracting Officer's Representative

for written approval before proceeding.

Ductile Iron Culvert Pipe; GA-RE

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE

Pipe for culverts, drainage structural pipe (pipe associated with gate well structures), pump station, closure structures, drainage systems and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

The sizes, classes and joint type are shown on the drawings.

2.1.1 Concrete Pipe

Reinforced concrete pipe shall be of the sizes and classes shown on the drawings with Wall B unless otherwise shown and shall conform to the applicable requirements specified in ASTM C 76 with concrete bell and spigot conforming to ASTM C 361 and with o-ring solid rubber gaskets conforming to ASTM C 361. ASTM C 76 pipe shall also meet the ultimate load requirements. Pipe lengths shall be 8-foot except as otherwise required. Where applicable and shown on the drawings, the reinforced concrete pipe shall be selected to match the existing storm drainage pipe which is to be extended. Where the materials of the pipe is not specified on the drawings, the Contractor must submit his choice of piping material to be used for each individual application to the Contracting Officer's Representative for written approval before proceeding. The manufacturer of the concrete pipe shall demonstrate, to the contractor and the COR , at the manufacturer's plant for each size pipe the method of homing joints and that joints can be homed, i.e., fully closed on either the exterior or the interior of the pipe. Also the manufacturer of the concrete pipe shall demonstrate, to the contractor and the COR , at the manufacturers plant for each size pipe the method of homing joints and that joints can be homed, i.e., full closed as required in the design.

2.1.2 Corrugated Steel Pipe

2.1.2.1 Fully Bituminous Coated

AASHTO M 190 Type A and ASTM A 760/A 760M zinc or aluminum (Type 2) coated pipe of either:

a. Type I pipe with annular or helical 2-2/3 by 1/2 inch corrugations.

2.1.2.2 Ductile Iron Culvert Pipe

Pipe shall conform to AWWA C151 and ASTM A 716 unless otherwise shown or specified.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from precast concrete.

2.2.2 Precast Reinforced Concrete Box

For highway loadings with 2 feet of cover or more or subjected to dead load only, ASTM C 789; for less than 2 feet of cover subjected to highway loading, ASTM C 850.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete not to be used in pipe shall conform to the requirements for 4000 psi concrete under Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231.

Expansion-joint filler material shall conform to ASTM D 1752, type I.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 5 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

Mortar shall be Type M in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Pointing mortar shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.3.3 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.4 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48, Class 35B. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. Gratings for gate wells are specified in Section 05502. For manhole covers see the drawings.

2.3.5 Joints

2.3.5.1 Half Length Pipe Sections

Two short length (4-feet) pipe sections shall be placed immediately upstream and downstream of manholes and gate wells. Short lenght pipe sections are not required for the pump station.

2.3.5.2 Doweled Cradle Joints

DELETED. Dowels shall be provided between the concrete cradle and the gatewells. The dowels shall be smooth steel, ASTM A36, 1.125 inches in diameter. One half of the dowel shall painted to prevent bond. The dowels shall be installed perpendicular to the joint. The cradle joint shall be coated with a bond break approved by the COR. At the pump station dowels shall be placed at the upstream and downstream ends of the first section of RCP adjacent to the pump station.

2.3.5.3 Termination of Cradles

Termination of cradles shall be as shown on the plans and shall terminate at a pipe joint.

2.3.5.4 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.3.5.5 Flexible Watertight Joints for Precast Reinforced Concrete Manholes

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph "HYDROSTATIC TEST ON WATERTIGHT JOINTS." Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.4 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.4.1 Fittings for Ductile Iron Pipe

Mechanical fittings shall conform to AWWA C110, rated for 150 psi. Push-on fittings shall conform to AWWA C110and AWWA C111, rated for 150 psi.

2.5 JOINTS

Joints installation shall comply with the manufacturer's instructions. Fittings and gaskets utilized for waste drains or industrial waste lines shall be certified by the manufacturer as oil resistant.

Joints in ductile iron pipe shall either be rubber gasketed push-on or rubber gasketed flanged.

DELETED

2.6 DUCTILE IRON PIPE JOINTING

Push-on joints shall conform to AWWA C111. No Mechanical joints shall be used. Flanged joints shall conform to AWWA C115.

2.7 CAST IRON SOIL PIPE JOINTING

Rubber gaskets for compression joints shall conform to ASTM C 564. Joints for acid resisting cast iron soil pipe shall be made with acid resistant non-asbestos packing. The packing shall not contain material which would affect adhesion of the joint sealing material to the pipe. Lead shall be suitable for caulking of joints.

2.8 STEEL LADDER

Steel ladder shall be provided at all locations and where located on the drawings. These ladders shall meet the requirements of Section, MISCELLANEOUS METALWORK.

2.9 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.9.1 Concrete Pipe

A hydrostatic test shall be made on the watertight joint types as follows. Only one sample joint of each type and pipe diameter needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C 443.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and

the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus the required amount in 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock (Unyielding Material) if unexpectedly encountered

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe.

3.1.3 Removal of Unstable Material if unexpectedly encountered

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph "BACKFILLING." When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the circular pipe in the lowest 30 percent of the outside diameter of the pipe, (see EM 1110-2-2902, Figure 3-2, first class bedding). The bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.1.1 Ductile Iron Pipe

Bedding for ductile iron pipe shall be as shown on the drawings.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or

damaged pipe shall not be used. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Where concrete cradles are required the RCP shall be supported prior to cradle placement with precast saddles minimum two saddles per pipe unit. Submit saddle details for approval. Saddles shall have reinforcing to splice with cradle steel. Splice lengths shall meet splice lengths shown on the drawings. Contractor may submit alternate saddle support details for approval. For RCP placement tolerances see section 03301. The joints of pipe shall be fully homed and maintained in the fully homed position following concrete cradle placement and concrete cradle final set. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Corrugated Steel	5
Ductile Iron Culvert	3
Concrete Pipe	1

3.3.1 All pipes

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated Metal Pipe

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243. Interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings. During transportation and installation, pipe or pipe arch and coupling bands shall be handled with care to preclude damage to the coating, paving or lining. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be as shown on the drawings.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as specified above. When not previously specified shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.2 Concrete Collars

Concrete collars shall be used to connect to existing pipe of different materials or which can't be mated. Collar details shall be as shown on the contract drawings. If not shown on contract drawings then as required to make storm drainage systems performance operational by the Contractors design by a professional engineer licensed in Missouri. Contractors design shall be approved by the Contracting Officer. Concrete shall have a minimum compressive strength of 4000 psi and meet the requirements of Sections, FORMWORK FOR CONCRETE and CONCRETE REINFORCEMENT.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, precast reinforced concrete, complete with frames and covers or gratings; and with fixed steel ladders where indicated.

3.5.2 Walls and Head walls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

These ladders shall meet the requirements of Section, MISCELLANEOUS METALWORK.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as defined in paragraph, "Determination of Density,"

to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under non traffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. A minimum of one (1) field density test per lift of backfill for every 400 feet of installation shall be performed. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING FOR REINFORCED CONCRETE PIPE

3.8.1 General

Pipe diameters less than 24-inch shall be tested for water exfiltration conforming to ASTM C 969. All joints for pipes 24-inch or larger shall be tested for leakage by low pressure joint testing with water.

3.8.2 Low Pressure Joint Testing

Low pressure joint testing shall be made using a joint tester. Joints are required to withstand the internal pressure equal to 6 pounds per square inch for a duration of 20 minutes per joint. The joint tester shall be a Cherne Joint Tester as manufactured by Cherne Industries of 5700 Lincoln Drive Minneapolis, MN 55436 at http://www.cherneind.com/ or approved equal. The unit shall have the gages calibrated, at no cost to the Government, by an independent testing laboratory approved by the Contracting Officer. The results shall be submitted to the Contracting Officer for approval prior to commencing testing.

3.8.3 Allowable Pressure Drop

The allowable pressure drop shall be determined by averaging the results of three 20-minute tests conducted at the required p.s.i. on a straight, non jointed section of pipe. Obtain approval from the Contracting Officer of allowable pressure drop calculations.

3.8.4 Joint Width

Following pipe placement, bedding (but prior to concrete cradle placement), and after the pipe has been homed, measurements shall be taken to ensure the width of the joints remain unchanged during the joint pressure test. The width of the joint shall be measured at four locations, 90 degrees

apart prior to the joint pressure test. These measurements shall be provided to the COR. The locations of these four measuresments shall be marked on the pipe at each joint. Following the joint pressure test the joint width shall be remeasured. An increase in the joint width of 1/8-inch or more shall require the joint to be re-homed and the joint test repeated at no cost to the Government.

3.8.5 Joint Pressure Test

Mark any joint which does not maintain the required pressure for the 20 minute duration. The following calculation is required: Required joint pressure = Test pressure - allowable Pressure Drop. Joints which fail to maintain pressure shall be disassembled and all inferior elements replaced. Joints shall be retested and corrections made as necessary to meet the above pressure test. After backfilling the pipe, the Contractor shall perform additional hydrostatic test on joints which by inspection do not appear to be watertight. Joints which fail shall be dissembled and all interior elements replaced. All work shall be approved by the Contracting Officer's Representative.

3.8.6 Exfiltration Test

Test shall be made prior to the installation of the concrete cradle. For pipe not on concrete cradle the trench shall be backfilled up to at least the lower half of the pipe prior to testing. Visible leaks encountered shall be corrected regardless of leakage test results. The exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet on lines requiring the exfiltration test is provided above both the water table and the top of the pipe at the upper end (highest elevation) of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

3.9 PIPELINE TESTING

Other pipe lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed

to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

-- End of Section --

SECTION 02700

ASPHALTIC CONCRETE INTERMEDIATE LEVELING AND SURFACE COURSES
(CENTRAL PLANT HOT MIX)
Sept/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

T 168-91	Sampling Bituminous Paving Mixtures
T 248-84	Reducing Field Samples of Aggregate to Testing Size
T 283-89	Resistance of Compacted Bituminous Moisture to Moisture Induced Damage

ASPHALT INSTITUTE

Manual Series No. 2 (MS-2)	Mix Design Methods For Asphalt Concrete Sixth Edition

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

C 29-91	Unit Weight and Voids in Aggregate
C 88-90	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 117-90	Materials Finer than 75-um (No. 200) Sieve in Minera1 Aggregates by Washing
C 127-88	Specific Gravity and Absorption of Coarse Aggregate
C 128-88	Specific Gravity and Absorption of Fine Aggregate
C 131-89	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in

	the Los Angeles Machine
C 136-84a	Sieve Analysis of Fine and Coarse Aggregates
C 183-88	Sampling and Acceptance of Hydraulic Cement
C 566-89	Total Moisture Content of Aggregate by Drying
D 75-87	Sampling Aggregates
D 140-88	Sampling Bituminous Materials
D 242-85 (R1990)	Mineral Filler for Bituminous Paving Mixtures
D 1461-85	Test Method for Moisture or Volatile Distillates in Bituminous Paving Mixtures
D1559-89	Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using marshall Apparatus
D 2041-94	Test Method for Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
D 2172-92	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
D 2726-90	Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
D 3381-92	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
D 4791-89	Flat or Elongated Particles in Coarse Aggregate
PS 90-97	Asphalt Content of Hot Mix Asphalt by the Ignition Method

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-08 Statements

Testing Laboratory; GA-RE

The following shall be in one transmittal:

Equipment; GA-KC

Mixing Plant; GA-KC

SD-09 Reports

The following shall be included in the composition of mixture transmittal

Composition of Mixture; GA-KC

Coarse Aggregate; GA-KC

Fine Aggregate; GA-KC

Mineral Filler; GA-KC

QC PRODUCTION OF AGGREGATE

Aggregate Gradation; GA-KC

Crushed Particle Test; GA-KC

Specific Gravity Test; GA-KC

SD-13 Certificates

The following shall be included in the composition of the mixture transmittal:

Bituminous Material; GA-KC

1.3 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.4 DEFINITIONS

1.4.1 General

Bituminous intermediate and surface course shall consist of fine and coarse aggregates and mineral filler uniformly mixed with hot bituminous material, and placed and compacted on a prepared base course, or intermediate course. All quality control sampling and testing results and reports shall be included in the Contractor's Daily Quality Control Reports.

1.4.2 Aggregates

Aggregates shall consist of crushed stone, crushed gravel, screenings, sand, and mineral filler. The portion of these materials retained on the 4.75 mm (No. 4) sieve shall be known as coarse aggregate; the portion passing the 4.75 mm (No. 4) sieve and retained on the 75 um (No. 200) sieve, as fine aggregate; and the portion passing the 75 um (No. 200), as mineral filler. The coarse and fine aggregates and mineral filler shall be so graded and of such character that when combined, a blend will be produced that will meet the requirements specified in paragraphs, "AGGREGATE GRADATION" and "COMPOSITION OF MIXTURE."

1.4.2.1 The total aggregate

The total aggregate (coarse aggregate, fine aggregate, and the material passing the 75 um (No. 200) sieve) shall contain not less than 80 percent crushed material for intermediate course and surface course.

1.4.2.2 Coarse aggregates

Coarse aggregates shall consist of clean, sound, durable fragments of crushed stone or crushed gravel meeting the following requirements:

a. Percent of wear shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131-89.

b. Percentage of loss shall not exceed 18 after five cycles performed in accordance with ASTM C 88-90, using magnesium sulfate.

c. The dry weight of crushed slag shall not be less than 1,200 Kg/cubic m (75 pcf),as determined in accordance with ASTM C 29-91.

d. Crushed gravel retained on the 4.75 mm (No. 4) sieve and each coarser sieve shall contain at least 80 percent by weight of crushed pieces having one or more fractured faces with the area of each face equal to at least 80 percent of the smallest midsectional area of piece. When two fractures are contiguous, the angle between planes of fractures shall be at least 30 degrees to count as two fractured faces.

e. Particle shape of crushed aggregates shall be essentially cubical. The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight, when determined in accordance with ASTM D 4791-89.

1.4.2.3 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles including natural sand or crushed stone or gravel that meets requirements for wear and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the 600 um (No. 30) sieve. This requirement shall apply to the material before blending with natural sand when blending is necessary.

1.4.2.4 Mineral filler

Mineral filler shall conform to ASTM D 242-85 (R1990) and the following additional requirements. At least 50 percent of the mineral filler shall be hydrated lime, limestone dust or Portland cement. However, in areas where long service has shown that there has been no problem with stripping when the proposed aggregates are used, this additional requirement may be waived by the Contracting Officer when requested in writing.

1.5 SAMPLING AND TESTING OF AGGREGATES

1.5.1 General

Sampling shall be performed in accordance with ASTM D 75-87 for aggregates and ASTM C 183-88 for mineral filler, unless otherwise directed. Quality control tests shall be performed at the frequency specified hereinafter. Aggregates shall not be delivered to the job site or used in the production of bituminous mixtures without prior approval.

1.5.2 Preconstruction Aggregate Testing

1.5.2.1 Initial tests (SD09-GA)

Initial tests (SD09-GA)

The Contractor shall perform the following tests on the aggregates prior to designing the mix.

a. Coarse aggregate: Wear (abrasion) test, soundness test, gradation test, and specific gravity test. A crushed particle (fractured-faces) test unless the coarse aggregate is crushed quarried rock.

b. Fine aggregate shall be tested to determine compliance with specification requirements and gradation.

c. Mineral filler shall be tested to determine compliance with specification requirements.

1.5.2.2 Quality control tests (SD09-GA)

Quality control tests (SD09-GA)

During production, aggregates shall be sampled and tested, as required. The test results reported for these samples will be the basis of approval of specific lots of aggregates for the gradation and paving-mixture requirements. Gradation and specific gravity shall not vary significantly. The frequency of testing shall be as follows:

a. One gradation test of aggregate for every 1,000 Metric tons (1,100 tons) of each size of aggregate as it is stockpiled.

b. One crushed particle (fractured faces) test for every 1,000 Metric tons (1,100 tons) of each size of coarse aggregate as it is stockpiled unless the material is crushed quarried rock or unless otherwise approved.

c. One specific gravity test for every 1,000 Metric tons (1,100 tons) of each size grouping of aggregate stockpiled.

1.6 BITUMINOUS MATERIALS (SD13-GA)

Bituminous material shall not be incorporated into the mix without prior approval. Bituminous materials to be mixed with mineral aggregates shall conform to the following:

1.6.1 Asphalt Cement

Asphalt cement shall conform to ASTM D 3381-92, viscosity grade: AC-20. A certified refinery analysis from the proposed source shall be furnished.

1.7 QUALITY CONTROL

1.7.1 General (SD08-GA)

All quality control sampling and testing shall be the responsibility of the Contractor in accordance with SECTION, CONTRACTOR QUALITY CONTROL and as specified herein. All sampling and testing shall be performed by a commercial testing laboratory with the capability of performing all the testing specified herein and shall be supervised by a registered professional engineer. The Contractor may elect to establish testing facilities of his own. However the Contractors laboratory shall have the capability of performing all the testing specified herein. No work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The Contractors testing laboratory shall be supervised by a registered professional engineer. The first inspection of the facilities shall be at the expense of the Government and any subsequent inspections required because of failure of the first inspection will be at the expense of the contractor. Such costs will be deducted from the total amount due the Contractor. The Government may perform verification tests as considered necessary.

PART 2 PRODUCTS

2.1 AGGREGATE GRADATION

Mineral aggregate shall be of such size that the percentage composition by weight, as determined by ASTM C 136-84a and C 117-90, will generally conform to the gradation shown below for the specific course shown on the drawings. Regardless of the gradation chosen by the Contractor, it shall be his responsibility to furnish a combined aggregate which will produce a bituminous mixture meeting all requirements specified herein, particularly those specified in paragraph "COMPOSITION OF MIXTURE" and any aggregate gradation which fails to produce a bituminous mixture meeting all

requirements specified shall be rejected and replaced with a satisfactory aggregate gradation at no additional cost to the Government, and with no extension of time due to any delay caused by such replacement.

Percentage Passing, by Weight

Sieve Size	Intermediate Course 19.0 mm (3/4 inch) Max.	Surface course 12.5 mm (1/2 inch) Max.
25.0 mm (1 inch)	100	--
19.0 mm (3/4 inch)	95-100	100
12.5 mm (1/2 inch)	--	--
9.5 mm (3/8 inch)	70-90	79-94
4.75 mm (No. 4)	--	60-77
2.36 mm (No. 8)	28-58	44-62
1.18 mm (No. 16)	--	--
600 um (No. 30)	12-36	22-39
300 um (No. 50)	--	--
150 um (No. 100)	--	--
75 um (No. 200)	2-7	2-7

Note: The job mix formula may have to fall outside the gradation band shown above in order to meet the test properties of the mixture shown in paragraph, "COMPOSITION OF MIXTURE."

2.2 COMPOSITION OF MIXTURE (SD09-GA)

2.2.1 Job-Mix Formula

The bituminous mix design shall be established by a laboratory approved as specified in paragraph: QUALITY CONTROL using the materials and properties specified herein. Certified test results of the job-mix formula and materials shall be submitted for approval at least 30 days prior to commencing construction to the Kansas City District, Attention ED-GL. No bituminous mixture shall be produced until the job-mix formula has been approved by the Contracting Officer. The formula will indicate the percentage of each sieve fraction of aggregate, and the percentage of asphalt and temperature of completed mixture when discharged from mixer. The job-mix formula will be allowed the following tolerances.

Aggr. passing 4.75 mm (No. 4) sieve or larger plus or minus 5%

Aggr. passing 2.36 mm (No. 8), 1.18 mm (No. 16), 600 um (No. 30), and 300 um (No. 50) sieves plus or minus 4%

Aggregate passing 150 um (No. 100) and 75 um (No. 200)sieves plus or minus 2%

Asphalt as determined by extraction tests plus or minus 0.25%

Temperature of mixing plus or minus 14 degrees C (+ 25 degrees F)

The bitumen content and aggregate gradation may be adjusted within the

limits of the tables specified herein to improve the paving mixtures, as directed. The percentages of each sieve fraction in the job-mix formula will be restricted to values such that the application of the above-listed tolerances will not cause the limits of the gradation tables to be exceeded.

NOTE: It shall be noted that when the gradation varies appreciably from the single point gradation used in the mix-design, the test properties of the mix will be out of specifications and the mix-design will have to be adjusted or redesigned. This condition can occur even though the gradation meets the tolerences specified above.

2.2.2 Mineral Filler and Hydrated Lime

The mixtures shall contain one percent hydrated lime by weight of the total aggregate, however this maybe waivered as stated in Part 1, paragraph, Mineral filler. The hydrated lime shall be added during, or ahead of, the addition of the asphalt cement. If minus No. 200 material is needed in addition to the one percent hydrated lime to comply with gradation requirements, mineral filler shall be added.

2.2.3 Test Properties of Bituminous Mixtures

The finished mixture shall meet the requirements described below when tested in accordance with ASTM D1559-89 and the volumetric properites of compacted paving mixtures as calculated by ASTM procedures using Chapter 4 of the Asphalt Institues Manual Series No. 2 (MS-2). The automatic Marshall Hammer may be used when it has be calibrated with a manual hammer. The material for the theoretical specific gravity ASTM D 2041-94 and the material for the Marshall specimens (pucks) shall be cured at 135 degrees C (275 degrees F) for 2 hours in a closed oven after the mix is produced in the laboratory. Also the plant-produced mixture shall not be tested until the mix is 2 hours old. The mixture shall not be reheated. The above procedure shall be used when the water-absorption as determined by ASTM C 127-88 and ASTM C 128-88 of any aggregate in the mixture exceeds 1.25 percent. All samples will be compacted with 50 blows of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

2.2.3.1 Stability, Flow and Voids

The mixture shall meet the following requirements:

Test Property	Surface Course	Intermediate Course
Stability, minimum	5300 N (1200 lbs)	5300 N (1200 lbs)
Flow, maximum, 0.254 mm (1/100-inch) units	16	16

Voids, total mix, percent (see Note 1)	3-5	3-5
% Voids in Mineral Aggregate (VMA)	(See Note 2)	
Voids filled with asphalt; percent (VFA)	65-75	65-75
The ratio of minus No. 200 material to %effective asphalt cement based on the weight of the aggregate	0.6-1.2	0.6-1.2

Note 1: The laboratory job mix formula shall have the percent voids in the total mix between 4 and 4.5 percent air voids. The voids in the total mix of the mix produced at the plant shall be continually adjusted to ensure the voids stay near the middle of the range of 3 to 5 percent.

Note 2: The minimum VMA percent shall conform to the requirements specified in Table 5.3 , Chapter 5 of the Asphalt Institute manual MS-2. To insure that the VMA is not to high, the gradation of the verified mix design behind the paver shall be adjusted to meet the requirements of the VMA as stated in Chapter 5, paragraph "Evaluation of VMA Curve" of the Asphalt Institute manual MS-2. The asphalt content should be just to the left-hand side of the low point on the VMA versus Asphalt Content percent, not on the Awet@ or right-hand increasing side of the curve.

Note 3: When the absorption is high the mixture will be tender until the asphalt is absorbed into the aggregate. Therefore it may be beneficial to silo the mixture at the plant for a time. This is more important when the truck haul is short.

c. Reduction in strength by saturation with water: The index of retained strength must be greater than 75 percent as determined by AASHTO T 283-89. Specimens shall be conditioned by freezing and thawing. When the index of retained strength is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime or by treating the bitumen with an approved antistripping agent. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime or antistripping agent added to bitumen shall be sufficient, as approved, to produce an index of retained strength of not less than 75 percent. No additional payment will be made to the Contractor for addition of antistripping agent required.

d. Extraction test shall be performed using ASTM D 2172-92 or PS 90-97.

2.2.4 Sampling, Testing, and Approval of Bituminous Mixtures During Construction:

2.2.4.1 General

Samples of plant mixtures shall be taken to determine conformance to the specified test properties of bituminous mixtures and to determine bitumen content and aggregate gradation. Quality Control sampling and testing shall be performed by the same testing laboratory that established the mix design. The Quality Control laboratory shall be approved as specified in paragraph, "QUALITY CONTROL" and as specified herein. All tests shall be performed expeditiously and results immediately furnished to the Contractor and Government representatives at the construction site or mixing plant. As a minimum the test results shall be reported on a form similar to the form "ASPHALTIC CONCRETE TEST" attached at the end of this Specification Section. Back up calculations shall be available at the laboratory and submitted in the project final report. If the mixture is out of specification or near the specified limits, the test report shall contain recommendations of how to correct the mix proportions. Construction operations shall cease when test results are not received and adjustments made within six hours after the mix comes out of the plant. The Government may perform verification tests as considered necessary. Mixtures that do not conform to the specified test properties shall be rejected. No payment will be made to the Contractor for mixtures rejected, for additional retesting, or for pavements or portions of pavement removed. T 168-91 Sampling Bituminous Paving Mixtures and T 248-84 Reducing Field Samples of Aggregate to Testing Size are to be used for sampling.

2.2.4.2 Testing frequence

a. One gradation test of hot bin material for conventional plants, or total aggregate material from the final feed belt for the dryer-drum mixer for dryer-drum plants, for each 500 Metric tons (550 tons) of hot mix produced. A minimum of two tests per day and a maximum of three tests per day during hot mix production will be required.

b. Two gradation tests of hot bin material for conventional plants, or total aggregate material from the final feed belt for the dryer-drum mixer for dryer-drum plants, during trial runs performed 10 days before start of production of paving mixtures. Additional tests may be directed by the Contracting Officer when necessary to adjust the plant.

c. Marshall tests: In order to verify the mix design the first set (3 specimens) of tests shall be taken when the plant has produced approximately 75 Metric tons (82.5 tons) of hot mix. Testing shall be repeated until the tests verify that the hot mix produced meets all the properties specified in paragraph: Test properties of bituminous mixtures. After verification of the mix one set (3 specimens) of tests shall be made for each 300 Metric tons (330 tons) of hot mix produced, except that a minimum of two sets per day and a maximum of four tests per day, shall be made. Test shall be taken from the placed bituminous mixture prior to compaction. Material for the sample shall be taken from the following locations; one each side of the plced bituminous mat and one in the center of the mat. A square pointed shovel shall be used for taking the sample and for evenly laying material back into the disturbed mat.

d. Extraction tests shall be made to determine bitumen content and aggregate gradation at the same frequency specified above for Marshall Tests. Gradation test shall also be made when new aggregate is delivered

to the plant.

NOTE: The results of the gradation test is very important in determining how to adjust the mix. After the gradation or the bitumen content has been adjusted to obtain the properties of the mix, this verified mix design becomes the project mix design. The plant settings may have to be adjusted again whenever the gradation of the materials change. When a change is made it shall be reported on the Marshall Test Report form.

e. Paving shall stop and the mixture shall be redesigned whenever any of the following occurs; three consecutive sets of marshall tests show the percent voids in the total mix are less than 3 percent or more than 5 percent; two consecutive sets of marshall tests show the percent voids in the total mix are less than 2 percent; two consecutive marshall tests show the voids filled with asphalt exceed 79 percent.

f. Retained strength tests: One set of tests shall be made for the first day's construction and thereafter whenever there is any change in materials or job-mix formula.

g. Moisture tests: The bituminous mixture shall be sampled and tested for moisture in accordance with ASTM D 1461-85 each time a gradation test is performed. Tests shall be taken from the placed bituminous mixture prior to compaction. Additional test shall be made when a significant change in the stockpiles occurs such as rain, delivery of new aggregates, or when visual inspections of the mix leaving the plant show segregation of asphalt resulting from escaping water vapor in the prepared mixture.

h. Sampling, testing, and approval of bituminous materials: During construction the Contractor shall furnish asphalt samples and certified test analysis for each shipment of material delivered to the project. The Government may perform verification tests as considered necessary. During construction, the Contractor shall furnish samples of each shipment of bituminous material received at the project and the samples will be tested and/or retained by the Government for record purposes until the completion of the contract. Sampling shall be in accordance with ASTM D 140-88.

2.3 APPROVAL OF PLANT, EQUIPMENT, MACHINES, AND TOOLS (SD08-GA)

All equipment used shall be subject to approval. Tentative approval of specific items shall be obtained before start of operations. Final approval will be given only after full-scale production has begun. All plant equipment, tools and machines used in the work shall be maintained in a satisfactory working condition at all times.

2.4 MIXING PLANTS (SD08-GA)

Mixing plants shall meet the requirements of the State's Department of Transportion's latest specification in effect when this project contract is awarded to the Contractor, except the temperature of the asphalt shall not

exceed 162.8 degrees C (325 degrees F) at anytime and the mixture discharged from the plant shall not exceed 148.9 degrees C (300 degrees F), or shall conform to the requirement hereinafter. The plant may be either a weigh-batch type or a continuous-mixing type of conventional plant or a dryer-drum mixing type plant provided the equipment has demonstrated suitability for producing finished mixtures similar to those required by these specifications. The plant shall have a suitable capacity to accomplish the work. Plants shall conform to subparagraph: Requirements for all plants, except that scale requirements apply only when weight proportioning is used, and in addition, shall conform to subparagraph: Special requirements for batch-mixing plants or special requirements for conventional continuous-mixing plants, below, as applicable.

2.4.1 Requirements for All Plants

These requirements apply to dryer-drum mixing process plants only as specifically referenced hereinafter.

2.4.1.1 Plant scales

Plant scales for any weigh box or hopper shall be of standard make and design, either of the beam or the springless-dial type and shall be sensitive to 0.5 percent of the maximum load required. Beam-type scales shall have a separate beam for each size aggregate, with a single telltale actuated for each beam, and a tare beam for balancing the hopper. Standard test weights accurate to plus or minus 0.1 percent shall be provided for checking plant scales

2.4.1.2 Equipment for preparation of bituminous material

Tanks for storage of bituminous material shall be capable of heating the material, under effective and positive control at all times, to the temperatures specified herein. Heating shall be accomplished by steam coils, hot oil or electricity. Continuous circulation between storage tank and mixer during the entire operating period shall be provided. Pipelines and other bituminous handling equipment shall be stream-jacketed or otherwise properly insulated to prevent heat loss. The storage-tank capacity shall be sufficient for at least a 1-day run.

2.4.1.3 Feeder for dryer

The plant shall be provided with adjustable mechanical feeders that feed each aggregate individually and in ratios required. Feeders shall have accurate and separate adjustments for proportioning each aggregate to be incorporated into the mix. Gates or other proportioning devices shall have locks for fastening the devices in any desired position. A separate bin or compartment shall be provided for each aggregate to be fed into the dryer.

2.4.1.4 Rotary dryers
shall be provided in sufficient numbers to heat and dry the aggregates to the temperature and the moisture content specified herein.

2.4.1.5 Plant screens
shall be capable of screening dry aggregate output of the dryers to the

sizes required for proportioning into the mix. The screen sizes shall be such as to properly fractionate the aggregates so that the total aggregate mixture may be controlled within the tolerances of the job-mix formula at operating capacity.

2.4.1.6 Bins

Bins of sufficient capacity to continuously supply the mixer when it is operating at full capacity shall be provided. The bins shall be divided into at least three compartments, arranged to insure separate and adequate storage of appropriate fractions of the aggregate. Each compartment shall be provided with an overflow pipe of such size and at such location as to prevent any backing up of material into other bins. Approved dry storage shall be provided for mineral filler; and provisions shall be made for accurately weighing or proportioning the mineral filler to the mixtures. Each aggregate bin shall be equipped with mechanical or electrical telltales to indicate when the aggregate in the bin is below the level that will permit accurate proportioning of the aggregate to the mixing unit. Each bin shall be constructed or equipped in such manner that a representative sample of hot aggregate may be readily and safely taken from each bin during plant operations.

2.4.1.7 Bituminous control unit

Satisfactory means, incorporating either weighing, metering, or volumetric measurements, shall be provided to obtain the required percentage of bitumen in the mix within the tolerances specified. When the quantity of bitumen is controlled by metering, provision shall be made whereby the amount of bitumen delivered through meter can be readily checked by weight.

2.4.1.8 Thermometric equipment

An armored thermometer with a range of 93.3 to 204.4 degrees C (200 to 400 degrees F) shall be fixed in the bituminous feed line near the discharge valve at the mixture unit. The plant shall be further equipped with an approved recording dial-scale, a mercury-actuated thermometer, or an electric pyrometer so placed at the discharge chute of the dryer as to register automatically or indicate the temperature of the heated aggregate.

2.4.1.9 Control of mixing time

Unless otherwise directed, the plant shall be equipped with positive means for governing and maintaining time of mixing constant. Interval of mixing shall be in accordance with subparagraphs: Mixer unit for batch method and Mixer unit for continuous method, specified below.

2.4.1.10 Dust collectors

The plant shall be equipped with dust collectors. Provisions shall be made to waste collected material or to return all or any part of the collected material uniformly to the mixture, as directed.

2.4.2 Special Requirements for Batch-Mixing Plants

2.4.2.1 Weigh box or hopper

Equipment shall include means for accurately weighing each bin size of aggregate in a weigh box or hopper suspended on scales, and these weigh boxes or hoppers shall be ample in size to hold a full batch without running over. The gates on both the bins and hoppers shall be constructed to prevent leakage of aggregate when closed. On manually operated plants, an interlocking device shall be provided to prevent opening more than one gate at a time. On automatic plants designed for simultaneous weighing of all sizes of aggregate, this provision does not apply while the plant is operating under automatic control.

2.4.2.2 Weigh bucket

The bitumen bucket shall have sufficient capacity to hold not less than 10 percent in excess of the weight of the bitumen required for one batch. The bitumen bucket shall be suspended on dial or beam scales equipped with a telltale so that the tare weight of the bucket will be shown for each weighing, and the net weight of the bituminous material will be measured within plus or minus 1 percent of the weight required. Use of a volumetric-metering-type device that will proportion the bitumen into the mix with the above accuracy will be permitted. The bucket shall be so arranged that the heated bituminous material will be delivered in a thin, uniform sheet, or in multiple streams the full width of the mixer, except in the case of a mixer where bituminous material is sprayed.

2.4.2.3 Mixer unit for batch method

The mixer shall be an approved twin-pugmill capable of producing a uniform mixture within job-mix tolerance specified. Batch capacity of the mixer shall be suitable to accomplish the work. The mixer shall have a time lock, accurate within five seconds, to control operation of the complete mixing cycle by locking the weigh-box gate after the mixer is charged until closing of the mixer gate at the completion of the cycle. The time lock shall lock the bitumen bucket throughout the dry-mixing period and shall lock the mixer gate throughout the dry and wet-mixing periods. The dry-mixing period is defined as the interval of time between opening of the weigh-box gate and application of bituminous material and opening of the mixer gate. Control of the time shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 3 minutes. A mechanical batch counter shall be installed as part of the timing device and shall be designed to register only the actuation of the bituminous-bucket release and to preclude register of any dry batches, or the register of any material through the operation of pulling bins. If not enclosed, the mixer box shall be equipped with an adjustable hood to prevent loss of mineral filler by dispersion. The clearance of the blades from all fixed parts shall not exceed 19.1 mm (3/4-inch).

2.4.3 Special Requirements for Conventional Continuous-Mixing Plants

2.4.3.1 Gradation control unit

The plant shall include means for accurately proportioning each bin size of aggregate either by weighing or measuring volumetrically. When gradation

control is by volume, the unit shall include a feeder mounted under the compartment bins. Each bin shall have an accurately controlled, lockable gate for volumetrically measuring material to be drawn from it. Indicators shall be provided on each gate to show the gate opening in inches.

2.4.3.2 Weight calibration of aggregate feed

The plant shall include means for calibration of gate openings by weight of test samples. The materials fed out of the bins through the individual orifices shall be bypassed to suitable test boxes. The plant shall be equipped to handle conveniently such test samples weighing approximately 181.4 Kg (400 pounds) combined weight of samples from bins, and not less than a 45.4 Kg (100 pounds) sample from any one bin. The size of the sample may be increased to 362.9 Kg (800 pounds) when so directed. A platform scale having sufficient capacity to accurately weigh the samples shall be provided. Mechanical means shall be provided to accurately proportion the mineral filler to the mixing plant.

2.4.3.3 Synchronization of aggregate and bitumen feed

Approved means shall be provided for interlocking control between flow of aggregate from bins and flow of bitumen from meter or other proportioning device.

2.4.3.4 Mixer

unit for continuous method shall be of an approved twin-pugmill type capable of producing a uniform mixture within the job-mix tolerances specified. Blades shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall bear a manufacturer's plate indicating the net volumetric contents of the mixer at the several heights inscribed on a permanent gate and the rate of feed of aggregate per minute of plant-operating speed. Unless otherwise required, determination of mixing time shall be by weight method, using the following formula.

$$\text{Mixing time in seconds} = \frac{\text{pugmill dead capacity in pounds}}{\text{pugmill output in pounds per second}}$$

Weights for the job will be determined by tests made by the Contracting Officer.

2.4.3.5 Discharge hopper

The pugmill shall be equipped with a discharge hopper having a capacity of approximately 910 Kg (1 ton). The hopper shall be equipped with dump gates that permit rapid and complete discharge of the bituminous mixture without segregation.

2.4.4 Requirements for Dryer-Drum Mixing Plants

Dryer-drum mixing plants shall conform to the following requirements. Equipment for preparation of bituminous material; feeder for dryer;

thermometric equipment; and safety requirements shall be as specified in paragraph, "REQUIREMENT FOR ALL PLANTS."

2.4.4.1 Aggregate supply and control

At least two aggregate storage bins shall be furnished and used to feed at least two separate sizes of aggregate. Each bin shall have the feed rate controlled by a variable speed belt, or a remotely operated gate, calibrated to accurately deliver any specified quantity of material. The feed rate from each bin shall be readily adjustable from the control panel to change aggregate proportions of aggregate from each bin when the combined aggregate delivery is increased or decreased. The combined aggregate belt feeding type dryer-drum shall be equipped with an approved belt scale. The belt scale shall operate automatic controls which will maintain the established proportion of the bitumen and the total aggregate, with provisions for readily changing the proportions. Approved means shall be provided for storing, metering, and feeding mineral filler as a separate material when a separate mineral filler is necessary.

2.4.4.2 Bituminous control unit

Approved means shall be provided to inject the required percentage of bitumen in the mix within the tolerances provided. Injection shall be so designed and controlled that no detrimental effect takes place form too close contact with dryer flame. Control of the quantity of bitumen injected shall be automatically linked to the aggregate feed scales as specified in the previous subparagraph. Provision shall be made so the amount of bitumen delivered can be checked by weight. Approved steam-jacketing or other insulation for maintaining the required temperature of bitumen in pipelines, meters, spray nozzles, etc., shall be provided. The system shall be capable of maintaining a continuous circulation of bituminous material.

2.4.4.3 Dryer-drum mixer

The dryer-drum mixer shall be an approved unit specially made for such operation by a manufacturer regularly engaged in production of such units and shall be a model which has a satisfactory record of use on previous jobs. Capacity shall be sufficient to supply the work under this contract without delay to any part of the construction operations. The unit shall be capable of effectively heating and drying the mineral aggregate as required and of effectively and completely combining the bitumen and all other materials into a uniform mixture with all aggregate particle thoroughly coated. Approved means shall be provided to maintain a constant rate of rotation of the dryer drum. The unit shall be equipped with automatic burner controls and shall provide approved means for temperature sensing of the bituminous mixture at discharge.

2.4.4.4 Holding bins

An approved holding bin or bins shall be provided to receive the hot

bituminous mixture as it discharges from the mixer.

2.5 OTHER EQUIPMENT

2.5.1 Bituminous-Materials Spreaders

Bituminous-materials spreaders shall be the self-propelled type equipped with hoppers, tamping, or vibrating devices, distributing screws, adjustable screeds operated either manually or automatically, equipment for heating the screeds and equalizing devices. The spreader shall be capable of spreading hot bituminous mixtures without leaving indented areas, tearing, shoving, or gouging and capable of producing a finished surface conforming to the smoothness requirements specified hereinafter. The spreader shall be capable of spreading hot bituminous mixtures without leaving indented areas, tearing, shoving, or gouging and capable of confining edge of strips to true lines without use of stationary side forms and capable of placing the course to the required thickness. If an automatic grade control device is used on the spreader for two-lane paving operations, it shall consist of sensing device for control of one end of the screed and a slope-control mechanism for control of the othcr end of the screed, or a sensing device on each side of the paving machine. Where the paver is used on multiple paving lanes (more than two paving lanes), sensing devices shall be used on each side of the spreader for control of the screed. The slope-control mechanism shall not be used for grade control in multiple paving lane operations.

2.5.2 Steel-Wheel Rollers

Steel-wheel rollers shall be self-propelled, three-wheel, (two-axle) and tandem (two-axle) types, weighing not less than 9,071.8 Kg (20,000 pounds) each. The three-wheel rollers shall have a minimum weight of 136 Kg per mm of width (300 pounds per inch of width) of rear wheel. Wheels shall be equipped with adjustable scrapers, water tanks, and sprinkling apparatus for keeping the wheels wet; thereby preventing the bituminous mixture from sticking to the wheels. Rollers shall be capable of reversing without backlash and free from worn parts. Roller wheels with flat and pitted areas or protections that leave marks in the pavement will not be permitted. Three-axle tandems will be permitted in lieu of two-axle tandems if approved by the Contracting Officer.

2.5.3 Heavy Pneumatic-Tired Rollers

Heavy pneumatic-tired rollers shall be self-propelled and shall consist of two axles on which are mounted multiple pneumatic-tire wheels in such manner that the rear group of wheels will not follow in the tracks of the forward group but spaced to give essentially uniform coverage with each pass. Axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. Tires shall be smooth and capable of being inflated to at least 621 KPa (90 p.s.i.) Construction of the roller shall be such that each wheel can be loaded to a minimum of 2,040 Kg (4,500 pounds).

2.5.4 Blowers and Brooms

Blowers and brooms shall be power type and suitable for cleaning the surface to be paved.

2.5.5 Saw and Core Drill

Saw and core drill shall be of the power type. The saw shall be capable of rapidly cutting pavement samples and trimming joints and edges of pavement. The core drill used for obtaining pavement samples shall be equipped with a diamond, tungsten carbide, or other bit capable of rapidly cutting a precision core sample 101.6 mm (4 inches) in diameter.

2.5.6 Small Tools

Small tools shall consist of rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heater for heating small tools, stilt sandals, and other small tools in numbers as required.

PART 3 EXECUTION

3.1 WEATHER LIMITATIONS

Bituminous courses shall be constructed only when the base course or intermediate course is dry and when the weather is not rainy. Unless otherwise directed, asphalt courses shall not be constructed when the temperature of the surface of existing pavement or base course is below 4.4 degrees C (40 degrees F).

3.2 PREPARATION OF SURFACE

3.2.1 Bituminous mixtures shall not be placed with-out ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided. Immediately prior to placing the bituminous base or surface course, all loose material, dirt, clay, or other objectionable material shall be removed from the surface.

3.2.2 If the surface of the underlying material has been damaged after placement or has inadequate compaction (soft spots) or other deviations from this contract specification requirements, such defects shall be repaired immediately prior to placement of the bituminous course. Trucks delivering materials shall be routed in a manner to minimize traveling over the subgrade during the placement operation. Paving operations shall be conducted in such a manner to prevent runoff water from being ponded on the subgrade in case of rain.

3.3 GRADE CONTROL

The lines and grades shown on the contract drawings shall be established and maintained by means of line and grade stakes placed at the site of the work by the Contractor in accordance with CONSTRUCTION CLAUSE: LAYOUT OF WORK. Elevations of bench marks used by the Contractor for controlling pavement operations at site of work will be determined, established, and maintained by the Government. Finished pavement gradelines and elevations shown shall be established and controlled at site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

3.4 MIXING

The bituminous mixtures shall be produced in a plant as specified hereinafter.

3.4.1 Conventional Plant

3.4.1.1 Preparation of mineral aggregates

Each component of various-sized aggregates blended in preparation of the bituminous mixture shall be placed and maintained in separate stockpiles. Various-sized aggregates shall be stockpiled to prevent segregation or intermixing. Bulldozers shall not be used for stockpiling aggregates or feeding aggregates to plant. The aggregate shall be fed into the cold elevator by separate mechanical feeders in a manner that will produce an aggregate graded within the requirements of the job mix formulas and tolerances specified. The aggregates shall be heated and thoroughly dried before entering the hot bins. The temperature and moisture content of the aggregate determined as it enters the mixer shall be uniform and such that the temperature and moisture content of the finished mixture will be uniform and within the tolerances specified. The heated and dried aggregates shall be screened and conveyed to separate hot bins ready for mixing with the bituminous material. The aggregate shall be separated into the sizes designated or approved, except that hot aggregate shall be separated into not less than three sizes. Approved dry storage shall be provided for mineral filler.

3.4.1.2 Preparation of bituminous mixtures

Each size of aggregate, prepared as specified hereinbefore, and dry mineral filler shall be accurately weighed or measured and conveyed into the mixer in the proportionate quantities required to meet the job-mix formula. The required amount of asphalt for each batch or calibrated amount for continuous mixing, shall be introduced into the mixer. In batch mixing, after the aggregates and mineral filler have been introduced into the mixer and mixed for not less than 5 seconds, the asphalt shall be added and the mixing continued for not less than 20 seconds and as much longer as may be required to obtain a homogeneous mixture. When a continuous mixer is employed, the mixing time shall be not less than 25 seconds, and as much longer as may be required to obtain a homogeneous mixture. Additional mixing time when required will be determined by the Contracting Officer. In no case shall the aggregate be introduced into the mixer at a temperature more than (-) 4 degrees C (25 degrees F) above the temperature of the asphalt. The temperature of the asphalt at the time of mixing shall not exceed 163 degrees C (325 degrees F). The temperature of the aggregate

and mineral filler in the mixer shall not exceed 177 degrees C (350 degrees F) when the asphalt is added. However, the temperature discharged from the plant shall not exceed 149 degrees C (300 degrees F). The temperatures of both the aggregate and asphalt at the time of mixing and the additional mixing time required shall be as determined by the Contracting Officer. When the mixture is prepared in a twin-shaft pugmill mixer, the volume of the aggregates, mineral filler, and asphalt shall not be so great that the mixture extends above the tips of the mixer blades when the blades are in a vertical position. All overheated and carbonized mixtures or mixtures which foam or show indications of moisture will be rejected. When moisture is detected in the finished mixture, all aggregate in the bins shall be removed immediately and returned to the respective stockpiles.

3.4.1.3 Water content of aggregates

During drying operations, the water content shall be reduced to less than 0.25 percent for aggregate blends with water absorption of 2.5 percent or less, and to less than 0.50 percent for aggregate blends with water absorption greater than 2.5 percent, absorption to be determined by ASTM C 127 and C 128. The water absorption for the aggregate blend shall be the weighted average of the absorption value for the coarse aggregate and the fine aggregate. The water content test shall be conducted in accordance with ASTM C 566-89. Water content for the blend will be a weighted average based on the composition of the blend.

3.4.2 Dryer-Drum Mixer

3.4.2.1 Preparation of mineral aggregates

The mineral aggregate shall be furnished in at least two separate sized materials. Each component of the various-sized aggregates to be blended in preparation of the bituminous mixture shall be placed in separate stockpiles in such manner that the separate sizes will not be intermixed and that segregation does not take place. Each size shall be stored in a separate bin without mixing, for feeding the dryer-drum mixer. The aggregate shall be fed into the dryer-drum mixer by the equipment previously specified in such manner that will produce a total aggregate graded within the requirements of the job-mix formula and tolerances specified. Moisture content of the aggregates fed to the dryer-drum mixer shall be as necessary to produce a bituminous mixture meeting all specified requirements.

3.4.2.2 Preparation of bituminous mixture

The aggregates and mineral filler shall be accurately weighed using the specified equipment and conveyed to the dryer-drum mixer in amounts required to conform to the job-mix formula. The required amount of asphalt shall be continuously injected into the dryer-drum mixer with the aggregate in the amount required by the job-mix formula, using the injection and control equipment previously specified. The temperature of the asphalt shall not exceed 163 degrees C (325 degrees F) at any time. The temperature of the bituminous mixture as discharged from the dryer-drum mixer shall not exceed 149 degrees C (300 degrees F). The speed of rotation of the drum, the temperature within the drum and time the mixture

is within the drum shall be controlled so as to produce a uniform bituminous mixture without segregation and with all aggregate particles thoroughly coated and conforming to all requirements of these specifications. All overheated and carbonized mixtures shall be rejected. Particular care shall be taken when commencing operations each day to reject any bituminous mixture that does not meet all requirements of these specifications.

3.4.2.3 Moisture test

Absorbed moisture in the aggregate shall be reduced to such a quantity that there is no objectionable segregation of asphalt resulting from escaping water vapor in the prepared mixture. A maximum of 0.5 percent moisture based on weight of the mixture, will be allowed in the mixture when sampled behind the paver and tested in accordance with ASTM D 1461.

3.5 TRANSPORTATION OF BITUMINOUS MIXTURE

The bituminous mixture shall be transported from the mixing plant to the site in trucks having tight, clean, smooth beds coated with a minimum amount of a concentrated solution of hydrated lime and water to prevent adhesion of the mixture to the truck beds. Each load of mixture shall be covered with canvas, or other suitable material of ample size to protect the mixture from the weather and to prevent loss of heat. Deliveries shall be scheduled so that spreading and rolling of all mixture prepared for one day's run can be completed during daylight unless approved adequate artificial lighting is provided. The mixture shall be delivered in such manner that the temperature at the time of dumping into the spreader will be not less than hereinafter specified. Loads that have crusts of cold, unworkable material or have become wet by rain will be rejected. Hauling over freshly placed material will not be permitted.

3.6 PLACING

Intermediate course, or any layer of surfaace source shall not be left uncovered by the subsequent course for more than 5 days, weather permitting. Material trucks hauling materials other than asphaltic concrete or tack coat shall not travel on previously constructed layers of asphaltic concrete until the final surface course is constructed.

3.6.1 Surface Preparation of Underlying Course

Prior to placing of the intermediate or surface course, the underlying course shall be cleared of all foreign or objectionable matter with power blowers, power brooms, or hand brooms. A tack coat shall be applied between the intermediate and surface course mixture. The tack coat between layers of recently constructed inter-mediate course, or layers of recently constructed surface course, may have the application rate reduced when specifically approved if the surface of the previously placed layer as approved is entirely free of dust, dirt or other foreign matter which might reduce the bond between the layers of the intermediate or surface course. Tack coat shall not be completely omitted.

3.6.2 Offsetting Joints in Intermediate and Surface Courses

The surface course shall be placed so that longitudinal joints of the surface course will not coincide with joints in the intermediate course by approximately 230 mm (9 inches). Care shall be taken when possible to offset longitudinal joints in a manner that the final surface course joint is in the center of the pavement or on a lane line. Transverse joints in the surface course shall be offset by at least two feet from transverse joints in the intermediate course.

3.6.3 General Requirements for Use of Mechanical Spreader

The range of temperatures of the mixture, when dumped into the mechanical spreader shall be as determined by the Contractor. Asphalt mixtures having temperatures less than 113 degrees C (235 degrees F) when dumped into a mechanical spreader will be rejected. The mechanical spreader shall be so adjusted and its speed so regulated that the surface of the course being placed will be smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface will conform with the cross section, grade, and contour shown on the drawings. Unless otherwise directed, placing shall begin along the centerline of areas paved on a crowned section or on the high side of areas with a one-way slope, and shall be in the direction of the major traffic flow. The mixture shall be placed in consecutive adjacent strips having a minimum width of 3.05 meters (10 feet), except when edge lanes require strips less than 3.05 meters (10 feet) to complete an area. Each strip placed before a succeeding strip shall be of such length that sufficient heat will be retained to make the strip readily compactible so that a joint can be obtained conforming to the requirements for texture, density, and smoothness specified in the paragraph: JOINTS. The length of any strip to be laid prior to the succeeding strip shall be as directed and may be decreased or increased as dictated by changes in climatic conditions. Longitudinal joints and edges shall be constructed to true line markings. The Contractor shall establish lines parallel to the centerline of the area to be paved and shall place string lines coinciding with established lines for the spreading machine to follow. Number and location of lines shall be as directed. Placing of the mixture shall be as nearly continuous as possible, and the speed of placing shall be adjusted, as directed, to permit proper rolling.

3.6.3.1 Special Procedures to Prevent Segregation

The wings of the spreader hopper shall not be emptied (flipped) between truck loads. The screed auger shall be operated approximately three-fourths (3/4) full and the hopper conveyor shall not be allowed to run out of material.

3.6.4 Special Requirements for Placing Strips Succeeding Initial Strips

In placing each succeeding strip after the initial strip has been spread and compacted as specified hereafter, the screed endgate of the mechanical spreader shall overlap the previously placed strip slightly and shall be 1.25 times thicker than the existing compacted strip in order to produce a smooth compacted joint with the specified density. Mixture placed on the edge of the previously placed strip by the mechanical spreader shall be

pushed back (tucked) to the edge of the strip being placed by use of a lute (rake). The pushed back material shall form a ridge on the uncompacted strip along the edge of the previously placed strip. The height of the ridge above the uncompacted strip should be approximately equal to the thickness being allowed for roll down during compaction. Procedures similar to these outlined above shall be used to facilitate getting a smooth joint with density. When the quantity of mixture on the previously placed strip plus uncompacted material in the strip being placed exceeds that required to produce a smooth, dense joint, the excess mixture shall be removed and wasted. Excess material shall not be spread over the uncompacted mat.

3.6.5 Shoveling, Raking, and Tamping After Machine Spreading

A sufficient number of experienced shovelers and rakers shall follow the spreading machine, adding hot mixture and raking the mixtures as required to produce a course that, when completed, will conform to all requirements specified herein. Broadcasting or fanning of mixture over areas being compacted will not be permitted. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected. Irregularities in alignment of the course left by the mechanical spreader shall be corrected by trimming directly behind the machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping laterally with a lute. Distortion of the course during tamping will not be permitted.

3.6.6 Hand Spreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread uniformly with hot shovels and hot rakes in a loose layer of a thickness that, when compacted, will conform to the required grade and thickness. During hand spreading, each shovelful of mixture shall be carefully placed by turning the shovel over in a manner that will prevent segregation. In no case shall the mixture be placed by throwing or broadcasting from a shovel. The loads shall not be dumped faster than can be properly handled by the shovelers and rakers.

3.7 COMPACTION OF MIXTURE

3.7.1 General

Compaction of the mixture shall be accomplished using a minimum of 2 steel-wheel rollers and a pneumatic-tired roller specified above. Rolling shall begin as soon after placing as mixture will bear roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the Contractor under supervision of the Contracting Officer. Before rolling is continued, deficiencies shall be corrected so that finished course will conform to requirements for grade and smoothness specified herein. Further smoothness checks shall be made by the Contractor as directed by the Contracting Officer. After preliminary smoothness tests, rolling shall be continued until density is obtained in all portions of each course of not less than 95 percent of density of laboratory compacted Marshall specimens taken behind the paver.

3.7.2 Density Tests

Density of the compacted mixture of the surface or intermediate course shall be determined by tests made on specimens taken from the compacted course in accordance with the requirements of paragraph, "SAMPLING PAVEMENTS." Specimens shall be tested in accordance with the requirements of ASTM D 2726-90.

3.7.3 Operation of Rollers, Tampers and Vibro Plate Compactors

3.7.3.1 The speed of rollers shall be slow enough at all times to avoid displacement of the hot mixture. Displacement of the mixture resulting from reversing the direction of the roller or from any other cause shall be corrected at once by use of rakes, and fresh mixture shall be applied or removed when necessary. Alternate passes of the roller shall be varied slightly in length. During rolling, the wheels of steel-wheel rollers and plates of vibro plate compactors shall be moistened to prevent adhesion of the mixture to the wheels or plates, but excess water will not be permitted. Tires of heavy pneumatic roller shall be moistened with soapy water when required to prevent mixture from sticking to tires during rolling. Rollers shall not be permitted to stand on finished courses until the courses have thoroughly cooled. The minimum number of rollers shall be adequate to obtain the specified density. Places inaccessible to rollers shall be thoroughly compacted with hot hand-tampers or vibro plate compactors.

3.7.3.2 Unless otherwise directed by Contracting Officer, a pneumatic-tired roller shall be used as an intermediate roller. Longitudinal joints shall be pinched to ensure compaction with the pneumatic-tired roller. The roller shall make at least one complete pass (forward and backward) operated on the hot lane as the intermediate roller. The roller shall be operated with its outside tire as close as possible to the previously placed lane.

3.7.4 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed. Skin patching of an area that has been rolled will not be permitted. Holes the full thickness of the course shall be cut so that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Edges shall be sprayed with bituminous materials conforming to the requirements of Section, BITUMINOUS TACK AND PRIMECOATS. Sufficient fresh paving mixture shall be placed in the holes so that finished surface will conform to the grade and smoothness requirements. The paving mixture shall be compacted to the density specified herein.

3.8 JOINTS

3.8.1 General

Joints between old and new pavements or between successive day's work, or joints that have become cold because of delay, shall be tacked and shall be

made carefully to insure continuous bond between old and new sections of the course. All joints shall have the same texture, density, and smoothness as other sections of the course. The tack shall be overlapped onto the previous pavement 25 mm (1 inch) or 50 mm (2 inches). Contact surfaces of previously constructed pavements, curbs, gutters, manholes, etc., shall be tacked. If these surfaces have become coated with dust, sand, or other objectionable material shall be cleaned by brushing or cut back with an approved power saw, as directed. The surface against which new material is to be placed shall be sprayed with a thin, uniform coat of bituminous material conforming to the requirements of Section, BITUMINOUS TACK AND PRIME COATS. The material shall be applied far enough in advance of placement of the fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

3.8.2 Transverse Joints

The roller shall pass over the unprotected end of freshly placed mixture only when placing of the course is discontinued or when delivery of mixture is interrupted to the extent that unrolled material may become cold. In all cases, the edge of the previously placed course shall be cut back to expose an even, vertical surface the full thickness of the course. In continuing placement of strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling which conforms to the required density and smoothness specified herein. When required, the fresh mixture shall be raked against the joints, thoroughly tamped with hot tampers, smoothed with hot irons and rolled.

3.8.3 Longitudinal Joints

Longitudinal joints in surface course or intermediate course shall be offset as stated in specification paragraph: Offsetting Joints in Intermediate and Surface Courses. Procedures outlined in specification paragraph: Special Requirements for Placing Strips Succeeding Initial Strips shall be followed when making longitudinal joints. Edges of previously placed strips that have cooled or are irregular, honeycombed, poorly compacted, damaged, or otherwise defective, and unsatisfactory sections of the joint shall be cut back to expose a clean, sound surface for the full thickness of the course as directed. When required, fresh mixtures shall be raked against the joint, thoroughly tamped with hot tampers, smoothed with hot irons and rolled.

3.9 EDGES OF PAVEMENT

Edges of pavement adjacent to the shoulders shall be trimmed neatly to line. Shoulder material not less than 0.3 meters (1 foot) wide shall be placed against and to the full height of the pavement surface as soon as practicable after final rolling has been completed and the pavement has sufficiently hardened.

3.10 PROTECTION OF PAVEMENT

After final rolling of the pavement, no vehicular traffic of any kind shall be permitted until the pavement has cooled and hardened or for at least 6

hours.

3.11 SURFACE REQUIREMENTS

Finished surface of bituminous courses, when tested as specified below shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

3.11.1 Plan Grade

The grade of the completed surface shall not deviate more than 1.5 mm (0.05 foot) from the plan grade.

3.11.2 Bituminous Intermediate Course

Upon completion of final rolling the surface of the intermediate course, if any, shall be smooth and true to grade and cross section. When a 12-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall not vary more than 1/4 inch from the straightedge. Surface irregularities exceeding these requirements shall be corrected as directed. Testing for plan-grade conformance and surface smoothness shall be performed by the Contracting Officer immediately after rolling is completed. Tests shall be made at intervals as directed.

3.11.3 Bituminous Surface Course

The surface course, upon completion of final rolling, shall be smooth and true to grade and cross section. When a 3.66 meters (12-foot) straightedge is laid on the surface parallel with the centerline, the surface shall not vary more than 3.2 mm (1/8 inch) from the straightedge. When the 3.66 meters (12-foot) straightedge is laid on the surface transverse to the centerline between the crown and edge of payment, the surface shall not vary more than 6.4 mm (1/4 inch) from the straightedge. Low or defective areas shall be immediately corrected by cutting out the faulty areas with fresh, hot mixture, and compacting the area to conform to the remainder of the pavement. Testing for plan-grade conformance and surface smoothness shall be performed by the Contractor in the presence of a representative of the Contracting Officer immediately after rolling is completed. Tests shall be made at intervals as directed.

3.11.4 Equipment

The Contractor shall furnish and maintain at the site, in good condition, one straightedge for each bituminous paver, for use of the Contracting Officer in testing the finished surface. Straightedges shall be aluminum or other approved lightweight metal and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on the pavement. Where devices other than straightedges are approved for surface smoothness determination, the Contractor shall furnish and maintain in good condition at the site, one such device for each bituminous paver.

3.12 SAMPLING PAVEMENTS

Samples of finished pavement, including samples that span the longitudinal joints, shall be obtained by the Contractor. A minimum of one test (three cores or sawed samples) shall be taken for each tonage lot represented by a Marshall test. The three cores or sawed samples shall be taken at locations throughout the tonage lot. The locations shall not be previously marked. Sample shall be taken at locations determined by the Contracting Officer. Additional samples shall be taken and testedat the start of the paving operations when directed. One-half of the samples shall be cut from longitudinal joints. The Contracting Officer may require additional testing at no additional cost to the Government. The Government may also perform verification tests as considered necessary. Cores shall be at least 101.6 mm (4 inches) in diameter and sawed samples at least 127.0 mm (5 inches) on each side. The samples shall be tested by the Contractor to determine conformance to density, thickness and, if directed, other specified requirements. All quality control sampling and testing shall be the responsibility of the Contractor in accordance with Section CONTRACTOR QUALITY CONTROL, paragraph, "QUALITY CONTROL" and as specified herein. Samples of each day's production shall be taken by noon of the following day and results of tests reported to the Contracting Officer by the end of that day. The Contractor shall furnish a power saw or core drill and labor for cutting samples and shall immediately replace the pavement. Sample holes shall have all surfaces tacked. Hot-mix bituminous mix shall be compacted in the sample hole to the satisfaction of the Contracting Officer. The finished surface of the repaired sample hole shall be sealed by mopping with tack coat.

3.13 INSPECTION OF PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of equipment in use, for inspecting operation of plant, verifying weights, proportions, and character of materials, and for checking temperatures maintained in preparation of mixtures. Checks so made shall not relieve the Contractor from performing all work as specified.

-- End of Section --

SECTION 02721

RIGID BASE COURSE
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1993) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate n Place by Nuclear Methods (Shallow Depth)

ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO-RE.

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-08 Statements

Material Source; GA-RE.

Source of the material to be used for producting aggregates in accordance with subparagraph, "Approval of Materials." This shall be submitted with the report below

SD-09 Reports

Sampling and Testing; GA-RE.

Copies of initial and in-place test results.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved testing laboratory in accordance with Section, CONTRACTOR QUALITY CONTROL. Tests shall be performed at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved.

The materials shall be tested to establish compliance with the specified requirements.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance with AASHTO T 180, Method D.

1.4.2.4 Density Tests

Density shall be field measured in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown on the drawings shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

1.4.2.5 Soundness Test

Soundness tests shall be made in conformance with ASTM C 88.Text

1.4.2.6 Wear Test

Wear tests shall be made on rigid base course material in conformance with ASTM C 131.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

a. Sieve Analysis not including 0.02 mm size material
b. Liquid limit and plasticity index moisture-density relationship
c. Wear Test
d. Soundness Testfoot

1.4.3.2 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted rigid base course. Samples shall be taken for each 835 square yards of each layer of material placed in each area and not less than on test for each day's placement.

a. Sieve Analysis not including 0.02 mm size material
b. Field Density
c. Moisture liquid limit and plasticity index

1.4.4 Approval of Material

The source of the material shall be selected at least 60 days prior to the time the material will be required in the work. Initial approval of the source will be based on an inspection by the Contracting Officer. Initial approval of material will be based on tests of samples for the specific job. Final approval of both the source and the material will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted rigid base course.

1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.6 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Rigid Base Course

Aggregates shall consist of crushed stone or gravel, screenings, natural sand, or other clean, sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the No. 4 sieve shall have a percentage of wear not to exceed 40 percent after 500 revolutions when tested as specified in ASTM C 131, and have a loss not greater than 24 percent weighted average at 5 cycles when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The percentage of flat and/or elongated particles shall not exceed 20 in the fraction retained on the 1/2 inch sieve and in the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the course aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the face. Gradation requirements specified herein shall apply to the completed compacted material. When 2 fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces. Aggregates shall have a maximum size of 2.0 inches and be graded continuously well within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3	No. 4
No. 10	50	80	--	85
No. 200	15	15	15	15

Liquid limit and plasticity index requirements stated herein shall apply to any aggregate component that is blended to meet the required gradation and also to the aggregate in the completed aggretgate surface. The portion of any blended component and of the completed course passing the No. 40 sieve shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

All clearing, stripping and excavating work involved in the opening or operation of aggregate sources shall be performed by the Contractor. Aggregate sources shall be opened to working depth in a manner that produces excavation faces that are as nearly vertical as practicable for the materials being excavated. Materials excavated from aggregate sources shall be obtained in successive cuts extending through all exposed strata. All pockets or strata of unsuitable materials overlying or occurring in the

deposit shall be wasted as directed. The methods of operating aggregate sources and the processing and blending of the material may be changed or modified by the Contracting Officer, when necessary, in order to obtain material conforming to specified requirements. Upon completion of work, aggregate sources on Government reservations shall be conditioned to drain readily, and shall be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws and authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the rigid base course, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the rigid base course is placed.

3.4 GRADE CONTROL

The finished and completed rigid base course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the rigid base course material at the water content specified. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory rigid base course.

3.6 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 6 inches is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is

required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

3.7 COMPACTION

Each layer of the rigid base course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph, "SAMPLING AND TESTING." In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory rigid base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.8 PROOF ROLLING

Areas designated on the drawings to be proof rolled shall receive an application of 30 coverages with a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 30,000 pounds and inflated to a minimum of 150 psi. A coverage is defined as the application of one tire print over the designated area. In the areas designated, proof rolling shall be applied to the top layer of the rigid base course. Water content of the top layer of the rigid base course shall be maintained such that the water content is within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph, "SAMPLING AND TESTING." Any material in the rigid base course or in the underlying materials indicated to be unsatisfactory by the proof rolling shall be removed, dried, and recompacted, or removed and replaced with satisfactory materials.

3.9 EDGES

Approved material shall be placed along the edges of the rigid base course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the rigid base course, as directed.

3.10 SMOOTHNESS TEST

The surface of each layer shall not show deviations in excess of 3/8 inch when tested with a 12 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.11 THICKNESS CONTROL

The completed thickness of the rigid base course shall be in accordance with the thickness and grade indicated on the drawings. The thickness of each course shall be measured at intervals providing at least one measurement for each 500 square yards or part thereof of the rigid base course. The thickness measurement shall be made by test holes, at least 3 inches in diameter through the course. The completed rigid base course shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, the Contractor shall correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown.

3.12 MAINTENANCE

The rigid base course shall be maintained in a satisfactory condition until accepted.

-- End of Section --

SECTION 02722

GRADED, CRUSHED AGGREGATE BASE COURSE AND RIGID BASE COURSE
12/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1993) Moisture-Density Relations of Soils Using a 10-lb. (4.54 kg) Rammer and an 18-in (457 mm) Drop

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow

	Depth)
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes
ASTM E 548	(1994) General Criteria Used for Evaluating Laboratory Competence

1.2 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D. This will be abbreviated herein after as percentage of laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO-RE

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-08 Statements

Material Source; GA-KC

Source of the material to be used for producting aggregates in accordance with subparagraph: Approval of Materials. This shall be submitted with the report below.

SD-09 Reports

Sampling and Testing; GA-KC

SAMPLING AND TESTING; GA-KC

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor, subject to approval.

Copies of initial and in-place test results.

1.4 EQUIPMENT

1.4.1 Approval

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as indicated.

1.4.2 Weather Limitation

Base courses shall be placed when the atmospheric temperature is above 35 degrees F. Areas of completed base course that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirement.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor, subject to approval. If the Contractor elects to establish its own testing facilities, approval of such facilities shall be based on compliance with ASTM E 548, and work requiring testing will not be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections, required because of failure of the first inspection, shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. The materials shall be tested to establish compliance with the specified requirements. Copies of test results shall be furnished to the Contracting Officer.

1.5.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Initial Tests

One of each of the following tests shall be performed on the proposed material, prior to commencing construction for each source of material: Sieve analysis, wear test, soundness, liquid limit and plasticity index, and moisture-density relationships. Test results shall be submitted to the Contracting Officer prior to commencing construction.

1.5.2.1 Sieve Analyses

Sieve analyses shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Testing Frequency

Testing frequency for sieve analysis, liquid limit and plasticity index: Results shall varify that the material complies with the specifications. After the initial test, a minimum of one analysis shall be performed for each 1,000 metric ton (1,000 tons) of material placed, with a minimum of one analysis for each day's placement until the base course is completed. When the source of materials is changed or deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced.

1.5.2.5 Density Tests

Density shall be measured in the field in accordance with ASTM D 1556 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration of the ASTM publication. Tests performed in accordance with ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed. Not less than one test shall be made to determine the field density of the compacted base course for each 1000 square meters (1000 square yards) of each layer of material placed and not less than one test for each day's placement.

1.5.2.4 Soundness Test

Soundness tests shall be made in conformance with ASTM C 88.

1.5.2.5 Wear Test

Wear tests shall be made in conformance with ASTM C 131.

1.5.3 Approval of Material

The source of the material to be used for producing aggregates shall be selected 60 days prior to the time the material will be required in the work. Tentative approval of the source will be based on an inspection by the Contracting Officer. Tentative approval of material will be based on tests of samples for the specific job. Final approval of both the source and the material will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted base course.

1.6 MEASUREMENT AND PAYMENT

1.6.1 Bidding Schedule Items

Bidding Schedule item Pavement Reconstruction. Bidding Schedule item for the North West Platte Road Raise. Bidding Schedule item for Crushed Rock Surfacing.

1.6.2 Payment

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of crushed stone or crushed gravel, and screenings. The Contractor shall obtain materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein, after compaction operations have been completed. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregates

Coarse aggregates shall be angular particles of uniform density. The coarse aggregate shall have a loss not greater than 24 percent weighted averaged at 5 cycles when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The coarse aggregate shall have a percentage of wear not to exceed 40 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles shall not exceed 20 in the fraction retained on the 1/2 inch sieve and in the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having 2 or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the plane. When 2 fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces.

2.1.2 Fine Aggregate

Fine aggregate shall be natural sand or angular particles produced by crushing stone or gravel that meets the requirements for wear and soundness

specified for coarse aggregate.

2.1.3 Gradation Requirements

Gradation requirements specified shall apply to the completed base course. The aggregates shall have a maximum size of 2 inches. Material to be used as base course shall be graded continuously within the limits specified in TABLE I. Material to be used as crushed aggregate surfacing shall be graded according to gradation number 2 or gradation number 3 in TABLE I. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2 inch	100	--	--
1-1/2 inch	70-100	100	--
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

NOTE 1: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements stated herein shall apply to any aggregate component that is blended to meet the required gradation and also to the aggregate in the completed base course. The portion of the aggregate passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.2 PREPARATION OF UNDERLYING COURSE

Prior to constructing the crushed, aggregate base course, the underlying course shall be cleaned of all foreign substances. At the time of construction of the base course, the underlying course shall contain no frozen material. The underlying course shall be compacted to +/- 2% of optimum water content and a minimum of 95% of maximum laboratory density as determined by AASHTO T 180. Ruts or soft, yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements specified shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

3.3 GRADE CONTROL

During construction, the lines and grades, including crown and cross slope indicated for the base course, shall be maintained by means of line and grade stakes placed by the Contractor.

3.4 MIXING OF MATERIALS

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make such adjustments in mixing procedures or in equipment as may be directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to ensure a satisfactory base course meeting requirements of this specification.

3.5 PLACING

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers, when compacted, shall be true to the grades or levels required, with the least possible surface disturbance. Where the base course is placed in more than 1 layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Adjustments in placing procedures or equipment shall be made as directed, to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to ensure an acceptable base course.

3.6 COMPACTION

3.6.1 Requirements

Each layer of base course, including shoulders, shall be compacted to produce an average field-measured density, through the full depth, of at least 100 percent of laboratory maximum density obtained in the laboratory

for graded crushed aggregate base course and 95 percent of laboratory maximum density for rigid base course. Water content shall be maintained during the compaction procedure and subsequent proof rolling of designated areas. Water content shall be within plus or minus 2 percent of optimum water content, as determined from laboratory tests and as specified in density test procedures listed in paragraph, "SAMPLING AND TESTING." In places not accessible to the rollers, the base course material shall be compacted with mechanical tampers.

3.6.2 Finishing

The surface of top layer of base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of top layer of base course is 1/2 inch or more below the grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompacted to bring to grade. Adjustments in rolling and finishing procedures shall be made as may be directed to obtain grades, to minimize segregation and degradation of base course material, to adjust the water content, and to ensure an acceptable base course. Material found unacceptable shall be removed and replaced, as directed, with acceptable material.

3.7 EDGES OF BASE COURSE

Acceptable material shall be placed along the edges of the base course that will compact to the thickness of the course being constructed. When the course is being constructed in 2 or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

3.8 SMOOTHNESS TEST

The surface of the top layer shall not deviate more than 3/8 inch when tested with a 10 footstraightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 3/8 inch shall be corrected as directed.

3.9 THICKNESS CONTROL

The completed thickness of the base course shall be within 1/2 inch of the thickness indicated. The thickness of the base course shall be measured at intervals of one measurement for at least each 500 square yards of base course. The depth measurement shall be made by test holes at least 3 inches in diameter. Where the measured thickness of the base course is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replacing with new material. Where the measured thickness of the base course is 1/2 inch more than indicated, it will be considered as conforming with the requirements plus 1/2 inch, provided the surface of the base course is within 1/2 inch of established grade. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness indicated.

3.10 MAINTENANCE

The base course shall be maintained in a condition that will meet specification requirements until accepted.

MATERIAL SOURCES

Riprap, bedding, and coarse aggregates for cast-in-place concrete meeting the requirements of these specifications can be produced from the approved sources listed in Specification Section, GENERAL.

-- End of Section --

SECTION 02731

AGGREGATE SURFACE COURSE
01/98

PART 1 GENERAL

Aggregate surface course shall be used for the road surface constructed along the levee centerline.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 3740	(1996) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 4318	(1995a) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated herein as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; FIO.

List of proposed equipment to be used in performance of construction work including descriptive data.

SD-09 Reports

Sampling and Testing; GA. DENSITY TESTS; GA.

Calibration curves and related test results shall be submitted prior to using the device or equipment being calibrated. Copies of field test results shall be submitted within 24 hours after the tests are performed. Test results from samples, shall be submittednot less than 30 days before material is required for the work. Results of laboratory tests for quality control purposes shall be approed, prior to using the material.

weight certificates; GA

1.4 EQUIPMENT

All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by the Contractor, subject to approval. If the Contractor elects to establish its own testing facilities, approval of such facilities will be based on compliance with ASTM D 3740. No work requiring testing will be permitted until the Contractor's facilities have been inspected and approved.

1.5.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Testing

1.5.2.1 Gradation

Aggregate gradation shall be made in conformance with ASTM C 117, ASTM C 136, and ASTM D 422. Sieves shall conform to ASTM E 11.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.3 Approval of Materials

The source of the material to be used for producing aggregates shall be selected 30 days prior to the time the material will be required in the work. Approval of sources not already approved by the Corps of Engineers will be based on an inspection by the Contracting Officer. Tentative approval of materials will be based on appropriate test results on the aggregate source. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted surface course.

1.6 WEATHER LIMITATIONS

Aggregate surface courses shall not be constructed when the ambient temperatures is below 35 degrees F and on subgrades that are frozen or contain frost. It shall be the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Surfaces damaged by freeze, rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of natural

gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor shall be responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction and proof rolling operations have been completed.

2.1.1 Coarse Aggregates

The material retained on the No. 4 sieve shall be known as coarse aggregate. Coarse aggregates shall be reasonably uniform in density and quality. The coarse aggregate shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ASTM C 131. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein.

2.1.2 Fine Aggregates

The material passing the No. 4 sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

Gradation requirements shall meet the requirements of Type 1 aggregate from Section 1007, of the Missouri State Highway commission Standard Specifications, 1996 edition.

2.2 LIQUID LIMIT AND PLASTICITY INDEX REQUIREMENTS

The portion of the completed aggregate surface course passing the No. 40 sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specification requirements in the specified time limit. Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.2 STOCKPILING MATERIALS

Prior to stockpiling the material, the storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled in such a manner that will prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING COURSE SUBGRADE

The subgrade shall be compacted to 95 percent of maximum laboratory dry density according to paragraph, "Density."

3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course shall be maintained by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CONTRACT REQUIREMENTS.

3.5 LAYER THICKNESS

The aggregate material shall be placed in a five inch layer of uniform thickness.

3.6 COMPACTION

Each layer of the aggregate surface course shall be compacted with approved compaction equipment. The water content during the compaction procedure shall be maintained at optimum or at the percentage specified by the Contracting Officer. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

3.7 EDGES OF AGGREGATE-SURFACED ROAD

Approved material shall be placed along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed.

3.8 THICKNESS CONTROL

The completed thickness of the aggregate surface course shall be within 1/2 inch, plus or minus, of the thickness indicated on plans. The thickness of the aggregate surface course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of the aggregate surface course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course. When the measured thickness of the aggregate surface course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to the Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed. Where the measured thickness of the aggregate

surface course is more than 1/2 inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated. When the average job thickness fails to meet this criterion, the Contractor shall, at no additional expense to the Government, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed.

3.9 DENSITY TESTS

Density shall be measured in the field in accordance with ASTM D 2922. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals, as directed.

3.10 WEAR TEST

Wear tests shall be made in conformance with ASTM C 131.

3.11 MAINTENANCE

The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --

SECTION 02748

BITUMINOUS TACK AND PRIME COATS
01/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 20	(1970) Penetration Graded Asphalt Cement
AASHTO M 81	(1992) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975) Cut-Back Asphalt (Medium-Curing Type)
AASHTO M 226	(1980) Viscosity Graded Asphalt Cement
AASHTO T 40	(1978; R 1983) Sampling Bituminous Materials

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 2027	(1976; R 1992) Cutback Asphalt (Medium-Curing Type)
ASTM D 2397	(1994) Cationic Emulsified Asphalt
ASTM D 2995	(1993) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-09 Reports

Tests; GA-RE.

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.4 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 50 degrees For above and when the temperature has not been below 35 degrees F for the 12 hours prior to application.

1.5 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 977 or ASTM D 2397, for Type ss-1, ss-1h, css-1, or css-1h.

2.2 PRIME COAT

Cutback asphalt shall conform to ASTM D 2027, Grade MC-30 or MC-70.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

MC-30	85-190 degrees F
MC-70	120-225 degrees F

Emulsions

SS-1	70-160 degrees F
SS-1h	70-160 degrees F
CSS-1	70-160 degrees F
CSS-1h	70-160 degrees F

*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous materialused shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous

materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 100 feet for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph, "FIELD QUALITY CONTROL."

-- End of Section --

SECTION 02754
CONCRETE PAVEMENTS FOR SMALL PROJECTS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1996) Standard Specification for Structural Concrete
ACI 305R	(1991) Hot Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1997) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 123	(1996) Lightweight Pieces in Aggregate
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 192/C 192M	(1995) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete

ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595	(1998) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 666	(1992) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1077	(1997) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ARMY CORPS OF ENGINEERS (COE)

COE CRD-C 130	(1989) Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete (rigid) pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section,

including tolerances for both.

1.3 ACCEPTABILITY OF WORK

The pavement will be accepted on the basis of tests made by the Government and by the Contractor or its suppliers, as specified herein. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing. Concrete samples shall be taken by the Contractor at the placement to determine the slump, air content, and strength of the concrete. Test cylinders shall be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed into service. All air content measurements shall be determined in accordance with ASTM C 231. All slump tests shall be made in accordance with ASTM C 143. All test cylinders shall be 6 by 12 inch cylinders and shall be fabricated in accordance with ASTM C 192/C 192M, using only steel molds, cured in accordance with ASTM C 31/C 31M, and tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory.

1.3.1 Evaluation Sampling

Sampling, testing, and mixture proportioning shall be performed by a commercial Testing Laboratory, conforming with ASTM C 1077. The individuals who sample and test concrete and concrete constituents shall be certified as American Concrete Institute (ACI) Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete shall be certified as ACI Concrete Construction Inspector, Level II. All mix design, weekly quality control reports, smoothness reports, and project certification reports shall be signed by a Registered Engineer.

1.3.2 Surface Testing

Surface testing for surface smoothness and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

1.3.2.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 1 when checked with the straightedge.

TABLE 1
STRAIGHTEDGE SURFACE SMOOTHNESS--PAVEMENTS

Pavement Category	Direction of Testing	Tolerances inches
Roads and Streets	Longitudinal	3/16
	Transverse	1/4

1.3.2.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between these two high points.

1.3.3 Edge Slump Testing and Conformance

When slip-form paving is used, not more than 15 percent of the total free edge of the slipformed portion of the pavement, shall have an edge slump exceeding 1/4 inch and no slab shall have an edge slump exceeding 3/8 inch. Edge slump shall be determined as above for surface smoothness, at each free edge of each slipformed paving lane constructed. Measurements shall be made at 5 to 15 foot spacings, and as directed. When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete for the entire width of the paving lane within these limits of excessive edge slump shall be removed and replaced. Adding concrete or paste to the edge or otherwise manipulating the plastic concrete after the sliding form has passed, or patching the hardened concrete, shall not be used as a method for correcting excessive edge slump.

1.3.4 Plan Grade Testing and Conformance

The finished surface of the pavements shall conform, within the tolerances shown in Table 1, to the lines, grades, and cross sections shown. The finished surface of new abutting pavements shall coincide at their juncture. The surfaces of pavements shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

1.4 PRECONSTRUCTION TESTING OF MATERIALS

The Contractor shall not be entitled to any additional payment or extension of time because of delays caused by sampling and testing additional sources, or samples, necessitated by failure of any samples. Aggregates

shall be sampled and tested by the Test Laboratory and shall be representative of the materials to be used for the project. Test results, signed by a Registered Engineer, shall be submitted 45 days before commencing paving. No aggregate shall be used unless test results show that it meets all requirements of these specifications, including compliance with ASTM C 33 and deleterious materials limitations.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; .

Manufacturer's literature on the concrete plant; mixing equipment; hauling equipment; placing and finishing, and curing equipment; at least 7 days prior to start of paving.

SD-07 Schedules

Paving; .

Paving Schedules at least 7 days prior to start of paving.

SD-08 Statements

Mixture Proportions; G.

The report of the Contractor's mixture proportioning studies showing the proportions of all ingredients and supporting information on aggregate and other materials that will be used in the manufacture of concrete, at least 14 days prior to commencing concrete placing operations.

1.6 EQUIPMENT

1.6.1 Batching and Mixing

The batching plant shall conform to NRMCA CPMB 100, the equipment requirements in ASTM C 94, and as specified. Water shall not be weighed or measured cumulatively with another ingredient. All concrete materials batching shall meet ASTM C 94 requirements. Batching, mixers, mixing time, permitted reduction of mixing time, and concrete uniformity shall meet the requirements of ASTM C 94, and shall be documented in the initial weekly QC Report. If truck mixers are proposed for use in the work, all water and ingredients conforming to the mix design shall be batched to the drum at the plant, in which case no water shall be carried in the truck's water tank. The Contractor may hold back a portion of the mix water from the batching for later site addition, subject to specific approval. The weights of all water in the truck's drum and truck's water tank system must be included on the weigh ticket, and shall conform to the mix design for the concrete batched. Trucks shall not carry additional water, except that required to conform to the mix design. Trucks containing more water than required by the mix design shall be rejected, and the concrete batch wasted off-site. If the truck operator requires water at the site for rinsing his

drum he shall obtain the water on-site from another vehicle or source after the concrete batch has been placed. The Government inspector shall have inspection access at all times to the truck's water tank and the tank shall have a water gauge which is in good and readable condition. If the water tank contents can not be readily determined in the opinion of the government inspector the truck shall be immediately rejected from use in the work, and the batch wasted off-site. Truck mixers proposed for use shall conform to ASTM C 94, and shall be tested for uniformity immediately prior to use in the work. Certified copies of the laboratory testing for mixer uniformity shall be submitted for government approval prior to use of the truck mixer in the work.

1.6.2 Transporting Equipment

Transporting equipment shall be in conformance with ASTM C 94 and as specified herein. Concrete shall be transported to the paving site in rear-dump trucks, in truck mixers, or in agitators. Truck mixers for use with low slump concrete shall be designed with extra large blading and rear opening. Bottom-dump trucks shall not be used for delivery of concrete.

1.6.3 Delivery Equipment

When concrete transport equipment cannot operate on the paving lane, side-delivery transport equipment consisting of self-propelled moving conveyors shall be used to deliver concrete from the transport equipment and discharge it in front of the paver. Front-end loaders, dozers, or similar equipment shall not be used to distribute the concrete.

1.6.4 Paver-Finisher

The paver-finisher shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality pavement. The paver-finisher shall spread, consolidate, and shape the plastic concrete to the desired cross section in one pass. The paver-finisher shall be equipped with a full width "knock-down" auger, capable of operating in both directions, which will evenly spread the fresh concrete in front of the screed or extrusion plate. Immersion vibrators shall be gang mounted at the front of the paver on a frame equipped with suitable controls so that all vibrators can be operated at any desired depth within the slab or completely withdrawn from the concrete. The vibrators shall be automatically controlled so that they will be immediately stopped as forward motion of the paver ceases. The spacing of the immersion vibrators across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between vibrators shall not exceed 30 inches, and the outside vibrators shall not exceed 12 inches from the edge of the lane. The paver-finisher shall be equipped with a transversely oscillating screed or an extrusion plate to shape, compact, and smooth the surface.

1.6.4.1 Paver-Finisher with Fixed Forms

The paver-finisher shall be equipped with wheels designed to ride the forms, keep it aligned with the forms, and to spread the preventing deformation of the forms.

1.6.4.2 Slipform Paver-Finisher

The slipform paver-finisher shall be automatically controlled and crawler mounted with padded tracks. Horizontal alignment shall be electronically

referenced to a taut wire guideline. Vertical alignment shall be electronically referenced on both sides of the paver to a taut wire guideline, to an approved laser control system, or to a ski operating on a completed lane. Control from a slope-adjustment control or control operating from the underlying material shall not be used. Truck mixers shall not be used when slip form paver-finishers are used.

1.6.4.3 Other Types of Finishing Equipment

Clary screeds or other rotating tube floats will not be allowed on the project.

1.6.5 Curing Equipment

Equipment for curing is specified in paragraph, "CURING."

1.6.6 Texturing Equipment

Texturing equipment shall be as specified below.

1.6.6.1 Fabric Drag

A fabric drag shall consist of a piece of fabric material as wide as the lane width securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. The material shall be wide enough to provide 12 to 18 inches dragging flat on the pavement surface. The fabric material shall be clean, reasonably new burlap, kept clean and saturated during use .

1.6.6.2 Deep Texturing Equipment

Texturing equipment shall consist of a stiff bristled broom forming a drag at least 4 feet long. This drag shall be mounted in a wheeled frame spanning the paving lane and constructed to mechanically pull the drag in a straight line across the paving lane perpendicular to the centerline.

1.6.7 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-tip-bladed concrete saws mounted on a wheeled chassis.

1.6.8 Straightedge

The Contractor shall furnish and maintain at the job site one 12 foot straightedge for testing concrete surface smoothness. The straightedge shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement and pozzolan and shall conform to appropriate specifications listed below.

2.1.1 Portland Cement

Portland cement shall conform to ASTM C 150 Type I or II. The maximum C3A content shall be 5 percent.

2.1.2 High-Early-Strength Portland Cement

High-early-strength cement shall conform to ASTM C 150 Type III, with C3A limited to 5 percent .

2.1.3 Blended Cements

Blened cements shall not be used.

2.1.4 Pozzolan (Fly Ash)

Fly ash shall conform to ASTM C 618 Class C or F, including all the supplementary optional physical requirements.

2.1.5 Ground Granulated Blast-Furnace Slag (GGBF Slag)

Ground granulated blast-furnace slag shall conform to ASTM C 989 Grade 120.

2.2 AGGREGATES

Aggregates shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C 33 class 5s, including deleterious materials, abrasion loss and soundness requirements of ASTM C 33, and other requirements specified herein. Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing in concrete in accordance with ASTM C 666.

2.2.1 Coarse Aggregate

Coarse aggregate shall consist of crushed gravel, crushed stone, or a combination thereof. The nominal maximum size of the coarse aggregate shall be 3/4 inches. When the nominal maximum size is greater than 1 inch, the aggregates shall be furnished in two ASTM C 33 size groups, No. 67 and No. 4. The amount of deleterious material in each size of coarse aggregate shall not exceed the limits shown in ASTM C 33 Class 1N, 4M or 4S, depending on the weathering region, and the following limits:

a. Lightweight particles 1.0 max. percent by mass (ASTM C 123).

b. Other soft particles 2.0 max. percent by mass (COE CRD-C 130).

c. Total of all deleterious 5.0 max. percent by mass (substances listed in ASTM C 33 and above, exclusive of material finer than No. 200 sieve).

d. The separation medium for lightweight particles shall have a density of Sp. Gr. of 2.0.

2.2.2 Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles. All fine aggregate shall be composed of clean, hard, durable particles meeting the requirements of ASTM C 33 and the requirements

herein. The amount of deleterious material in the fine aggregate shall not exceed the limits in ASTM C 33and shall not exceed the following limits:

a. Lightweight particles (ASTM C 123) 1.0 percent max. by mass using a medium with a density of Sp. Gr. of 2.0.

b. The total of all deleterious material types, listed in ASTM C 33 and above, shall not exceed 3.0 percent of the mass of the fine aggregate.

2.3 CHEMICAL ADMIXTURES

Air-entraining admixture shall conform to ASTM C 260. An accelerator shall be used only when specified in paragraph SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES and shall not be used to reduce the amount of cementitious material used. Accelerator shall conform to ASTM C 494Type C. Calcium chloride and admixtures containing calcium chloride shall not be used. A water-reducing or retarding admixture shall meet the requirements of ASTM C 494. Type G or H admixtures are not allowed.

2.4 CURING MATERIALS

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300. Burlap shall be new or shall be clean material never used for anything other than curing concrete.

2.5 WATER

Water for mixing and curing shall be clean, potable, and free of injurious amounts of oil, acid, salt, or alkali.

2.6 JOINT MATERIALS

2.6.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D 1751 . Expansion joint filler shall be 3/4 inch thick.

2.6.2 Slip Joint Material

Slip joint material shall be 1/4 inch thick expansion joint filler conforming to ASTM D 1751.

2.6.3 Contraction Joint Inserts

Sawable contraction joint inserts shall conform to COE CRD-C 540. Nonsawable contraction joint inserts shall have sufficient stiffness to permit placement in plastic concrete without deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of resistance to sawing. Material for polyvinyl chloride inserts shall conform to COE CRD-C 572. No metal inserts of any kind shall be used.

2.7 REINFORCING

2.7.1 General

Reinforcing bars shall conform to ASTM A 615/A 615M Grade 60. Bar mats shall conform to ASTM A 184/A 184M. Reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce

the bond with concrete.

2.7.2 Steel Fiber Reinforcing

Minimum ultimate tensile strength of the fibers shall be 50000 psi. The maximum aspect ratio (length divided by diameter) shall not exceed 100. Fibers longer than 2-1/2 inches shall not be used. The fibers shall be deformed and shall be furnished in small bundles adhered with water soluble glue. Fiber reinforcing shall only be used where specifically indicated.

2.8 DOWELS AND TIE BARS

2.8.1 Dowels

Dowels shall be single piece, plain (non-deformed) steel bars conforming to ASTM A 615/A 615M Grade 60 or higher. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight.

2.8.2 Tie Bars

Tie bars shall be deformed steel bars conforming to ASTM A 615/A 615M Grade 60. Grade 60 or higher shall not be used for bars that are bent and straightened during construction.

2.9 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to ASTM C 881, Class as appropriate for each application temperature to be encountered; except, that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching for complete filling of spalls, wide cracks, and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed portland cement concrete, mortar, or freshly mixed epoxy resin concrete to hardened concrete shall be Type V, Grade as approved.

2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

Specified compressive strength, f'c, for concrete is 4000 psi at 28 days. Maximum allowable water-cementitious material ratio is 0.45 . The water-cementitious material ratio is based on absolute volume equivalency, where the ratio is determined using the weight of cement for a cement only mix, or using the total volume of cement plus pozzolan converted to an equivalent weight of cement by the absolute volume equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 4 to 7 percent. The maximum allowable slump of the concrete shall be 3 inchesfor pavement constructed with fixed forms. For slipformed pavement, the maximum allowable slump shall be 1-1/4 inches. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls

below the specified strength f'c by more than 500 psi. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

2.11 MIXTURE PROPORTIONS

2.11.1 Composition Concrete

Composition concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Fly ash, if used, shall be used only at a rate between 15 and 35 percent by mass of the total cementitious material. Admixtures shall consist of air entraining admixture and may also include accelerator, retarder, or water-reducing admixture. High range water-reducing admixtures and admixtures to produce flowable concrete shall not be used. No substitutions shall be made in the materials used in the mixture proportions without additional tests to show that the quality of the concrete is satisfactory.

2.11.2 Concrete Mixture Proportioning Studies

Trial design batches, mixture proportioning studies, and testing shall be the responsibility of the Contractor, and shall be performed by the Test Laboratory and signed by a Registered Engineer. No concrete pavement shall be placed until the Contracting Officer has approved the Contractor's mixture proportions. All materials used in mixture proportioning studies shall be representative of those proposed for use on the project. If there is a change in materials, additional mixture design studies shall be made using the new materials. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1. At least three different water-cementitious ratios, which will produce a range of strength encompassing that required on the project, shall be used. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content. Maximum sand content shall be 40 percent of the total aggregate SSD weight. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

2.11.3 Mixture Proportioning Procedure

The Contractor shall perform the following:

a. Fabricate, cure and test 6 test cylinders per age for each mixture at 7 and 28 days.

b. Using the average strength for each w/(c+p), plot the results from each of the three mixtures on separate graphs for w/(c+p) versus 28-day strength.

c. From the graphs select a w/(c+p) which will produce a mixture giving a 28-day strength equal to the required strength determined in accordance with the following paragraph.

2.11.4 Average Strength Required for Mixtures

In order to ensure meeting, during production, the strength requirements specified, the mixture proportions selected shall produce a required average strength, f'cr, exceeding the specified strength, f'c, in accordance with procedures in Chapter 3 of ACI 301, "Proportioning."

PART 3 EXECUTION

3.1 CONDITIONING OF UNDERLYING MATERIAL

Underlying material, base course , upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon.

3.2 WEATHER LIMITATIONS

3.2.1 Hot Weather Paving

The temperature of concrete shall not exceed 90 degrees F. Steel forms, dowels and reinforcing shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F.

3.2.2 Cold Weather Paving

The ambient temperature of the air at the placing site and the temperature of surfaces to receive concrete shall be not less 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used at any time. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Pavement damaged by freezing shall be completely removed and replaced at the Contractor's expense as specified in paragraph, "REPAIR, REMOVAL, AND REPLACEMENT OF SLABS."

3.3 CONCRETE PRODUCTION

3.3.1 General Requirements

Concrete shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 90 degrees F, the time shall be reduced to 30 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall show at least the mass, or volume, of all ingredients in each batch delivered, the water meter and revolution meter reading on truck mixers and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government daily.

3.3.2 Transporting and Transfer-Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. No equipment shall be allowed to operate on the prepared and compacted underlying material in front of the paver-finisher.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms or slipforms.

3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Operation

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 8 inches.

3.4.3 Required Results

The paver-finisher shall be operated to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing, other than the use of cutting straightedges, except in very infrequent instances. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms for overlay pavements and for other locations where forms must be set on existing pavements shall be held securely in place with stakes or by other approved methods. Holes in existing pavements for form stakes shall be carefully drilled without cracking or spalling the existing pavement. Prior to setting forms for paving operations, the Contractor shall demonstrate the proposed form setting procedures at an approved location and shall not proceed further until the proposed method is approved. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.5 Slipform Paving

The slipform paver shall shape the concrete to the specified and indicated cross section in one pass, and shall finish the surface and edges so that only a very minimum amount of hand finishing is required. Dowels shall not be installed by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete. If a keyway is required, a 26 gauge thick metal keyway liner shall be installed as the keyway is extruded. The keyway liner shall be protected and shall remain in place and become part of the joint.

3.4.6 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement, or may be placed on an initial layer of consolidated concrete, with the subsequent layer placed within 30 minutes of the first layer placement.

3.4.7 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels and tie bars in joints shall be omitted when the center of the dowel is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.7.1 Contraction Joints

Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels and tie bars shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.7.2 Construction Joints-Fixed Form Paving

Installation of dowels and tie bars shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.7.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the

dowel. Where tie bars are required in longitudinal construction joints of slipform pavement, bent tie bars shall be installed at the paver, in front of the transverse screed or extrusion plate. If tie bars are required, a standard keyway shall be constructed, and the bent tie bars shall be inserted into the plastic concrete through a 26 gauge thick metal keyway liner. Tie bars shall not be installed in preformed holes. The keyway liner shall be protected and shall remain in place and become part of the joint. Before placement of the adjoining paving lane, the tie bars shall be straightened, without spalling the concrete around the bar.

3.4.7.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

3.5 FINISHING

Clary screeds, "bridge deck" finishers, or other rotating pipe or tube type equipment shall not be permitted. The sequence of machine operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Hand finishing shall be used only infrequently and only on isolated areas of odd slab shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Equipment to be used for supplemental hand finishing shall primarily be 10 to 12 feet cutting straightedges; only very sparing use of bull floats shall be allowed. At no time shall water be added to the surface of the slab in any way, except for fog (mist) sprays to prevent plastic shrinkage cracking.

3.5.1 Machine Finishing With Fixed Forms

The machine shall be designed to ride the forms. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

3.5.2 Machine Finishing With Slipform Pavers

If there is sufficient concrete slurry or fluid paste on the surface that it runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

3.5.3 Surface Correction

While the concrete is still plastic, irregularities and marks in the pavement surface shall be eliminated by means of cutting straightedges, 10 to 12 feet in length. Depressions shall be filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. Long-handled, flat "bull floats" shall be used sparingly and only as necessary to correct

minor, scattered surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished.

3.5.4 Hand Finishing

Hand finishing operations shall be used only for those unusual slabs as specified previously. Grate tampers (jitterbugs) shall not be used. As soon as placed and vibrated, the concrete shall be struck off and screeded. The surface shall be tamped with a strike-off and tamping screed, or vibratory screed. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally. Long-handled, flat bull floats shall be used sparingly and only as necessary to correct surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Joints and edges shall not be overfinished. No water shall be added to the pavement during finishing operations.

3.5.5 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. Following initial texturing on the first day of placement, the Placing Foreman, Contracting Officer representative, and a representative of the Using Agency shall inspect the texturing for compliance with design requirements. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris. Any type of transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 1/2 inch of a true line. The concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement shall be finished to provide a surface of the same texture as the surrounding area. Surface texturing shall be selected to match the existing adjacent concrete pavement, and shall be subject to approval.

3.5.5.1 Fabric-Drag Surface Finish

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with a moist fabric drag. The dragging shall produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.5.5.2 Broom Texturing

Surface texture shall be applied using a mechanical stiff bristle broom drag of a type that will uniformly score the surface transverse to the pavement center line. The broom shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. The scores should be uniform in appearance and approximately 1/16 inchin depth but not more than 1/8 inch in depth. Hand brooming will be permitted only on isolated odd shaped slabs or slabs where hand finishing is permitted.

3.5.5.3 **DELETED**

3.5.5.4 **DELETED**

3.5.6 Edging

The edges of slipformed lanes shall not be edged. After texturing has been completed, the edge of the slabs along the forms shall be carefully finished with an edging tool to form a smooth rounded surface of 1/8 inch radius. No water shall be added to the surface during edging.

3.6 CURING

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. Unhardened concrete shall be protected from rain and flowing water. During hot weather with low humidity and/or wind, the Contractor shall institute measures to prevent plastic shrinkage cracks from developing. ACI 305R contains means of predicting plastic shrinkage cracking and preventative measures. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry. Curing shall be accomplished by one of the following methods.

3.6.1 Membrane Curing

A uniform coating of white-pigmented membrane-forming curing compound shall be applied to the entire exposed surface of the concrete including pavement edges as soon as the free water has disappeared from the surface after finishing. If evaporation is high and no moisture is present on the surface even though bleeding has not stopped, fog sprays shall be used to keep the surface moist until setting of the cement occurs. Curing compound shall then be immediately applied. Curing compound shall be applied to the finished surfaces by means of a self-propelled automatic spraying machine, equipped with multiple spraying nozzles with wind shields, spanning the newly paved lane. The curing compound shall be applied at a maximum application rate of 200 square feet per gallon. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs where indicated and on concrete surfaces exposed by the removal of forms. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel and that will be free from pinholes and other discontinuities. Areas where the curing compound develops the above defects or is damaged by heavy rainfall, sawing or other construction operations within the curing period, shall be immediately resprayed.

3.6.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Impervious sheet curing shall not be used.

3.7 JOINTS

No deviation from the jointing pattern shown on the drawings shall be made without written approval of the Design District Pavement or Geotechnical Engineer. All joints shall be straight, perpendicular to the finished grade of the pavement, and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch.

3.7.1 Longitudinal Construction Joints

Dowels and Tie bars shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated.

3.7.2 Transverse Construction Joints

Transverse construction joints shall be installed at a planned transverse joint, at the end of each day's placing operations and when concrete placement is interrupted. Transverse construction joints shall be constructed either by utilizing headers and hand placement and finishing techniques, or by placing concrete beyond the transverse construction joint location and then saw cutting full depth and removing concrete back to the transverse construction joint location. For the latter case, dowels shall be installed using methods for dowels installed in hardened concrete described above. All transverse construction joints shall be dowelled.

3.7.3 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using preformed joint filler of the type, thickness, and width indicated, and shall extend the full slab depth. Edges of the concrete at the joint face shall be edged. The joint filler strips shall be installed to form a recess at the pavement surface to be filled with joint sealant. Expansion joints shall be constructed with thickened edges for load transfer.

3.7.4 Slip Joints

Slip joints shall be installed the full depth of the slab using expansion joint preformed joint filler material attached to the face of the original concrete placement. A reservoir for joint sealant shall be constructed at the top of the joint. Edges of the joint face shall be edged.

3.7.5 Contraction Joints

Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw. Transverse contraction joints shall be constructed in conformance with requirements for sawed joints .

3.7.5.1 Sawed Joints

Sawed contraction joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the indicated depth. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Sawing at a given joint location shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. The surface shall be resprayed with curing compound as soon as free water disappears. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord or backer rod before the concrete in the region of the joint is resprayed with curing compound.

3.7.5.2 Insert-Type Joints

Insert-type joints shall not be used for slipformed pavements. Insert-type non-metallic contraction joints shall be constructed by installing a preformed insert in the plastic concrete to form a weakened plane to induce cracking. Inserts shall be installed using a machine equipped with a vibrating bar for cutting a groove in the plastic concrete for placement of the insert or for vibrating the insert into place at the prescribed joint location. The installed insert shall be perpendicular to the finished grade of the pavement, with the top of the insert not more than 1/8 inch below the pavement surface.

3.7.6 Thickened Edge Joints

Underlying material in the transition area shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.7.7 Special Joints

Special joints (undercut joints) shall be constructed adjacent to existing pavement as indicated. The concrete shall be worked under the edge of the existing pavement to completely fill the void and shall be thoroughly consolidated by the use of hand-held vibrators.

3.8 REPAIR, REMOVAL, AND REPLACEMENT OF SLABS

New pavement slabs that contain full-depth cracks shall be removed and replaced, as specified herein at no cost to the Government. Removal and replacement shall be full depth, shall be full width of the paving lane, and the limit of removal shall be from each original transverse joint . The Contracting Officer will determine whether cracks extend full depth of the pavement and may require minimum 6 inch diameter cores to be drilled on the crack to determine depth of cracking. Cores shall be drilled and the hole later filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin. Drilling of cores and refilling holes shall be at no expense to the Government. Cracks that do not extend full depth of slab shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1. The Contractor shall ensure that the crack is not widened during epoxy resin injection. Where a full depth crack intersects the original transverse joint, the slab(s) containing the crack shall be removed and replaced, with dowels installed, as required below. Spalls along joints shall be repaired as specified.

3.8.1 Removal and Replacement of Full Slabs

Unless there are keys or dowels present, all edges of the slab shall be sawcut full depth. If keys, dowels, or tie bars are present along any edges, these edges shall be sawed full depth 6 inches from the edge if only keys are present, or just beyond the end of dowels or tie bars if they are present. These joints shall then be carefully sawed on the joint line to within 1 inch of the depth of the dowel or key. The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. The narrow strips along keyed or doweled edges shall be carefully broken up and removed. Care shall be taken to prevent damage to the dowels, tie bars, or keys or to concrete to remain in place. Protruding portions of dowels shall be painted and lightly oiled. The joint face below keys or dowels shall be suitably trimmed so that there

is no abrupt offset. If underbreak occurs at any point along any edge, the area shall be hand-filled with concrete, producing an even joint face from top to bottom, before replacing the removed slab. If underbreak over 4 inches deep occurs, the entire slab containing the underbreak shall be removed and replaced. Where there are no dowels, tie bars, or keys on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete. Original damaged dowels or tie bars shall be cut off flush with the joint face. All four edges of the new slab shall thus contain dowels or original keys or original tie bars. Prior to placement of new concrete, the underlying material shall be graded and recompacted, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants, and coated with a double application of membrane forming curing compound as bond breaker. Placement of concrete shall be as specified for original construction. The resulting joints around the new slab shall be prepared and sealed as specified.

3.8.2 Repairing Spalls Along Joints

Spalls along joints and cracks shall be repaired by first making a vertical saw cut at least 1 inch outside the spalled area and to a depth of at least 2 inches. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete. The cavity shall be thoroughly cleaned with high pressure water jets supplemented with compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The cavity shall be filled with low slump portland cement concrete or mortar, or with epoxy resin concrete or mortar. Portland cement concrete shall be used for larger spalls, those more than 1/3 cu. ft. in size after removal operations; portland cement mortar shall be used for spalls between 0.03 and 1/3 cu. ft; and epoxy resin mortar or Type III, Grade 3 epoxy resin for those spalls less than 0.03 cu. ft. in size after removal operations. Portland cement concretes and mortars shall be very low slump mixtures, proportioned, mixed, placed, tamped, and cured. If the materials and procedures are approved in writing, latex modified concrete mixtures may be used for repairing spalls less than 1/3 cu.ft. in size. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions, mixing, placing, tamping and curing procedures as recommended by the manufacturer. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints.

3.8.3 Areas Defective in Plan Grade or Smoothness

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with a surface grinding machine after the concrete is 14 days or more old. The depth of grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the specified limits, shall be removed and

replaced. In pavement areas given a wire comb or tined texture, areas exceeding 25 square feet that have been corrected by rubbing or grinding shall be retextured by grooving machine sawn grooves meeting the requirements for the wire comb or tined texture. All areas in which grinding has been performed will be subject to the thickness tolerances specified in paragraph Thickness. Any grinding performed on individual slabs with excessive deficiencies shall be performed at the Contractor's own decision without entitlement to additional compensation if eventual removal of the slab is required.

3.9 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed as indicated and as specified in Section, DEMOLITION modified, and expanded as specified herein. Removal, repair and replacement shall be made as indicated and as specified in paragraph, "REPAIR, REMOVAL, AND REPLACEMENT OR SLABS."

3.10 PAVEMENT PROTECTION

The Contractor shall protect the pavement against all damage prior to final acceptance of the work. Traffic shall be excluded from the new pavement. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean. Special cleaning and care shall be used where Contractor's traffic uses or crosses active airfield pavement.

3.11 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL (CQC)

Paragraph "ACCEPTABILITY OF WORK" contains additional CQC requirements. The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and submit reports as specified. When, in the opinion of the Contracting Officer, the paving operation is out of control, concrete placement shall cease.

3.11.1 Batch Plant Control

A daily report shall be prepared indicating checks made for scale accuracy with test weights, checks of batching accuracy, and corrective action taken prior to and during placement for weighing or batching, type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water masses per cubic yd, amount of water as free moisture in each size of aggregate, and the batch aggregate and water masses per cubic yd. for each class of concrete batched during each day's plant operation.

3.11.2 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two other tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of paving. Whenever air content reaches specified limits, an immediate confirmatory test shall be made. If the second test also shows air content at or exceeding specified limits, an adjustment shall immediately be made in the amount of

air-entraining admixture batched to bring air content within specified limits. If the next adjusted batch of concrete is not within specified limits, concrete placement shall be halted until concrete air content is within specified limits.

b. Slump Testing. Slump tests shall be made when test specimens are fabricated. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Whenever slump approaches the maximum limit, an adjustment shall immediately be made in the batch masses of water and fine aggregate, without exceeding the maximum w/(c+p). When a slump result exceeds the specification limit, no further concrete shall be delivered to the paving site until adjustments have been made and slump is again within the limit.

c. Temperature. The temperature of the concrete shall be measured when strength specimens are fabricated.

d. Concrete Strength Testing. Four (4) cylinders from the same batch shall be fabricated, cured and tested for compressive strength, testing two cylinders at 7-day and two cylinders at 28-day age. A minimum of one set of four (4) cylinders shall be fabricated, cured and tested for each shift of concrete placement. Control charts for strength, showing the 7-day and 28-day CQC compressive strengths, and the 28-day required compressive strength, shall be maintained and submitted with weekly CQC Reports.

3.11.3 Inspection Before Placing

Underlying materials, joint locations and types, construction joint faces, forms, reinforcing, dowels, and embedded items shall be inspected by a Registered Engineer in sufficient time prior to each paving operation in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing, and the certification signed by the Registered Engineer, prior to each days' paving.

3.11.4 Paving Operations

The placing foreman shall supervise all placing and paving operations, shall determine that the correct quality of concrete is placed in each location as shown, shall insure that the concrete is consolidated full depth and that finishing is performed as specified. The placing foreman shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume of concrete placed, and method of paving and any problems encountered.

3.11.5 Curing Inspection

a. Moist Curing Inspections. Each day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded. When any inspection finds an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for the area shall be extended by 1 day.

b. Membrane Curing Inspection. At the end of each day's placement, the CQC Representative shall determine the quantity of compound

used by measurement of the container; shall determine the area of concrete surface covered; shall then compute the rate of coverage in square feet per gallon and shall also note whether or not coverage is uniform. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

3.11.6 Cold-Weather Protection

At least once per day, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.11.7 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report, signed by a registered engineer, shall be prepared for the updating of control charts and test data, and all CQC inspections and actions covering the entire period from the start of the construction through the current week. Reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all CQC records. A copy of weekly reports shall be faxed to the Design District Pavement or Geotechnical Engineer. At the completion of concrete placement, a certification report shall be prepared containing mix designs, all updated control charts and concrete test data, quality control reports, smoothness reports, and other pertinent data on the concrete, with a certification by a registered engineer that the concrete placed meets all specification requirements. A copy of the certification report shall be mailed to the Design District pavement or Geotechnical Engineer.

-- End of Section --

SECTION 02760

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in this text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM D 789	(1994) Determination of Relative Viscosity, Melting Point, and Moisture Content of Polyamide (PA)
ASTM D 3405	(1994) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements
ASTM D 3569	(1985; R 1991) Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements
ASTM D 5893	(1996) Cold Applied, Single Component Chemically Curing Silicon Joint Sealant for Portland Cement Concrete Pavement

CORPS OF ENGINEERS (COE)

COE CRD-C 525	(1989) Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-06 Instructions

Manufacturer's Recommendations; FIO RE.

Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of these

recommendations shall be submitted at least 30 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

SD-07 Schedules

Construction Equipment List; FIO RE.

List of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

SD-13 Certificates

Sealant and Back-up Materials; GA RE.

Certified certificate(s) with test data showing compliance with the laboratory test requirements. No material will be allowed to be used until it has been approved.

1.3 TEST REQUIREMENTS

Testing of the materials shall be performed in an approved independent laboratory and certified copies of the test reports shall be submitted and approved 60 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

1.4 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

1.4.1 Joint Cleaning Equipment

1.4.1.1 Tractor-Mounted Routing Tool

The routing tool used for removing old sealant from the joints shall be of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

1.4.1.2 Concrete Saw

A self-propelled power saw with water-cooled diamond or abrasive saw blades will be provided for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not

provide a clean joint.

1.4.1.3 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and shall be capable of furnishing not less than 150 cubic feet per minute and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Compressor capability under job conditions must be demonstrated before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjusted as necessary to secure satisfactory results.

1.4.1.4 Waterblasting Equipment

Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary resupply equipment shall be of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjustable as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch at which the equipment is operating.

1.4.1.5 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

1.4.2 Sealing Equipment

1.4.2.1 Hot-Poured Sealing Equipment

The unit applicators used for heating and installing joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

1.5 TRIAL JOINT SEALANT INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 200 feet long shall be prepared using the

specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. All other joints shall be prepared and sealed in the manner approved for sealing the test section.

1.6 DELIVERY AND STORAGE

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided by the Contractor at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

1.7 ENVIRONMENTAL CONDITIONS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Sealant shall not be applied if moisture is observed in the joint.

1.8 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

Area	Sealing Material
Rebuilt Sidwalks	ASTM D 3405 and COE CRD-C 525
Driving Surfaces and Connector Roads	ASTM D 3569 and COE CRD-C 525

2.2 PRIMERS

Primers, when their use is recommended by the manufacturer of the sealant, shall be as recommended by the manufacturer of the sealant.

2.3 BACKUP MATERIALS

The backup material shall be a compressible, nonshrinking, nonstaining, nonabsorbing material and shall be nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

The bond breaking tape or separating material shall be a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, the joints shall be thoroughly cleaned to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

3.1.1 Existing Sealant Removal

The in-place sealant shall be cut loose from both joint faces and to the depth shown on the drawings, using the tractor-mounted routing equipment, concrete saw or waterblaster as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any separating or backup material that is required to maintain the depth of new sealant to be installed. Prior to further cleaning operations, all loose old sealant remaining in the joint opening shall be removed by blowing with compressed air. Hand tools may be required to remove sealant from random cracks. Chipping, spalling, or otherwise damaging the concrete will not be allowed.

3.1.2 Sawing

3.1.2.1 Facing of Joints

Facing of joints shall be accomplished using a concrete saw as specified in paragraph EQUIPMENT to remove all residual old sealant and a minimum of concrete from the joint face to provide exposure of newly cleaned concrete, and, if required, to enlarge the joint opening to the width and depth shown on the drawings. The blade shall be stiffened with a sufficient number of suitable dummy (used) blades or washers. Immediately following the sawing operation, the joint opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris.

3.1.2.2 Refacing of Random Cracks

Sawing of the cracks shall be accomplished using a power-driven concrete saw as specified in paragraph EQUIPMENT. The saw blade shall be 6 inches or less in diameter to enable the saw to follow the trace of the crack. The blade shall be stiffened as necessary with suitable dummy (or used) blades or washers. Immediately following the sawing operation, the crack opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris.

3.1.3 Sandblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 1/2 inch from the joint edges shall be waterblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, curing compound, filler, old sealant residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

3.1.4 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, the lower portion of the joint opening shall be plugged or sealed off using a back-up material to prevent the entrance of the sealant below the specified depth. Care shall be taken to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.5 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, a bond breaker separating tape will be inserted to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. The tape shall be securely bonded to the bottom of the joint opening so it will not float up into the new sealant.

3.1.6 Rate of Progress of Joint Preparation

The stages of joint preparation which include sandblasting, air pressure cleaning and placing of the back-up material shall be limited to only that lineal footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

3.2.1 Hot-Poured Sealants

Sealants conforming to ASTM D 3405 and ASTM D 3569 shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation shall be withdrawn and

wasted.

3.2.2 Single-Component, Cold-Applied Sealants

The ASTM D 5893 sealant and containers shall be inspected prior to use. Any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory shall be rejected. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

3.3 INSTALLATION OF SEALANT

3.3.1 Time of Application

Joints shall be sealed immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, a final cleaning with compressed air shall be performed. The joints shall be filled from the bottom up to 1/4 inch plus or minus 1/16 inch below the pavement surface. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. The sealant shall be installed in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's instructions. Joints shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.4 INSPECTION

3.4.1 Joint Cleaning

Joints shall be inspected during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints shall be approved prior to installation of the separating or back-up material and joint sealant.

3.4.2 Joint Sealant Application Equipment

The application equipment shall be inspected to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.4.3 Joint Sealant

The joint sealant shall be inspected for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.5 CLEAN-UP

Upon completion of the project, all unused materials shall be removed from the site and the pavement shall be left in a clean condition.

-- End of Section --

SECTION 02763

PAVEMENT MARKINGS
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952	(Rev D) Paint, Traffic and Airfield Marking, Waterborne (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA-RE.

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

SD-06 Instructions

Mixing, Thinning and Application; FIO RE.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-08 Statements

SD-13 Certificates

Volatile Organic Compound (VOC) Content; FIO RE.

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

Paint certification; FIO RE.

Certificate stating that the proposed pavement marking paint meets the specification requirements of FS TT-P-1952.

1.3 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.4 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.5.1 Paint Application Equipment

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. . The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.5.5 Surface Preparation Equipment

1.4.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and

shall be equipped with traps that will maintain the compressed air free of oil and water.

1.4.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.4.3 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.4.3.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.4.3.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradeable residue.

1.4.4 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.5 HAND-OPERATED, PUSH-TYPE MACHINES

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.7 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

1.8 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for roads, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Pavements shall cure 30 days before marking, except at the culvert on 1 st

Division Road. Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified . The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.3 MARKING REMOVAL

Pavement marking, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph, "SURFACE PREPARATION." Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the

pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

-- End of Section --

SECTION 02821

FENCING
04/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 116	(1995) Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 121	(1992a) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(1998) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 176	(1997) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 478	(1997) Chromium-Nickel Stainless and Heat-Resisting Steel Weaving and Knitting Wire
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1997) Aluminum-Coated Steel Barbed Wire
ASTM A 666	(1996b) Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Paste, and Flat Bar
ASTM A 702	(1989; R 1994) Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1998) Ready-Mixed Concrete
ASTM D 4541	(1995) Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM F 626	(1996) Fence Fittings
ASTM F 668	(1996) Poly(Vinyl Chloride) (PVC)-Coated Steel Chain-Link Fence Fabric
ASTM F 883	(1997) Padlocks
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1998a) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

AMERICAN WOOD PRESERVERS ASSOCIATION (AWPA)

AWPA C1	(1997) All Timber products - Preservative Treatment by Pressure Processes
AWPA C4	(1995) Poles - Preservative Treatment by Pressure Processes

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-13 Certificates

Chain Link Fence; GA-RE.

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

1.3 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 2, zinc-coated steel wire with minimum coating weight of 2.0 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with a mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II , formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II , formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

2.5 WIRE

2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.7 BARBED WIRE

Zinc cated for use with sinc-coated fabric

2.8 CONCRETE

ASTM C 94, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.9 PADLOCKS

Padlocks shall conform to ASTM F 883, Type PO1, Option , Grade 6. , Size 1-3/4 inch. Allpadlocks shall be keyed alike. .

PART 3 EXECUTION

3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a inch clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 RAILS

3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

3.4.2 Bottom Rail

The bottom rail shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed

on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12 foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

3.6 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 4 inches of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 12 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 1 plus or minus 1/2 inch above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

3.8.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored to the posts in a manner to prevent easy removal with hand tools Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

3.10 GROUNDING

This applies to the Qundaro Pump Station.

Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 650 feet. Each gate panel shall be bonded with a flexible bond strap to its gate post. Fences crossed by power lines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4 inch by 10 foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 12 inches deep and radially from the fence. The top of the electrode shall be not less than 2 feet or more than 8 feet from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

-- End of Section --

SECTION 02840

VEHICLE BARRIERS AND CONSTRUCTION SIGNS
11/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

Missouri Highway and Transportation Commission (MODOT)

MODOT SEC 1042	Standard Specification for Highway Construction (HIGHWAY SIGN MATERIALS): TYPE 1

Missouri Standard Specifications for Highway Construction (MSSHC)

MSSHC Sec 01040	Division 1000, Materials Details Guard Rail and Guard Rail Cable Materials
MSSHC Sec. 712	zinc alloy stick method

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952	(Rev D) Paint, Traffic and Airfield Marking, Waterborne (Metric)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 106	(1997a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM C-33	AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)(1993) Concrete Aggregate (1993) Concrete Aggregates (1997) Concrete Aggregates
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1998) Structural Welding Code - Steel

FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA SA-89-006 (1988) Manual on Uniform Traffic Control Devices for Streets and Highways

National Cooperative Highway Research Program (NCHRP)

(NCHRP)Report 230 Sand Barrel Attenuators

1.2 GENERAL REQUIREMENTS

This Section covers signs for warning and control of traffic during construction, furnishing and placing all sand barrel attenuators, furnishing and erecting guard rail and guard cable in conformity with the lines and grades shown on the plans, or established by the Contracting Officer's Representative. Surfaces shall be painted in accordance with requirements of Section, PAVEMENT MARKINGS or PAINTING HYDRAULIC STRUCTURES except for materials supplied with manufacturer's standard finish.

1.2.1 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Vehicle Barriers and Construction Signs; GA-RE.

A complete list of equipment, materials, including industrial standards used and how they apply to the applicable component and manufacturer's descriptive data and technical literature, catalog cuts, and installation instructions.

Equipment Lists; GA-RE.

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of equipment shall include descriptive data and safety precautions required for the equipment operation.

SD-04 Drawings

Vehicle Barriers and Construction Signs; GA-RE.

Detail drawings containing complete layout and traffic schematic phasing diagrams, and any other details required. The drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances. Detail drawings shall include a copy of the crash test report or certificate of any barrier performance.

SD-08 Statements

Vehicle Barriers and Construction Signs; GA-RE.

Information necessary to document a minimum 1-year successful field operation performance history for each type of vehicle barrier or construction sign installed.

SD-09 Reports

Testing Data; GA-RE.

Test reports in booklet form showing all manufacture field tests, including component adjustments and demonstration of compliance with the specified performance criteria.

SD-13 Certificates

CONSTRUCTION SIGNS CERTIFICATION

Test reports in booklet form showing all manufacture field tests, including component adjustments and demonstration of compliance with the specified performance criteria.

SD-19 Operation and Maintenance Manuals

Vehicle Barriers and Construction Signs; GA-RE.

Six copies of operation and maintenance manuals. Manuals shall be approved prior to acceptance. Operation manuals shall outline the step-by-step procedures required for all traffic control startup, operation, and shutdown. Maintenance manuals shall include routine maintenance procedures guide. Also to cover winter spring, summer and fall operations.

1.4 DELIVERY AND STORAGE

Components placed in storage shall be protected from the weather, humidity, and temperature variation, dirt and dust, or other contaminants. Structural materials shall be stored on sleepers or pallets and shall be protected from rust and objectionable materials such as dirt, grease, or oil.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment

operating on roads shall display low speed traffic markings and traffic warning lights.

1.5.1 Water blast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.5.2 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flag persons, and related equipment for the safe passage of vehicles shall be provided.

1.7 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Water blasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 GUARD RAIL AND GUARD CABLE

Materials: All material shall conform to the Missouri Standard Specifications for Highway Construction (MSSHC) Division 1000, Materials Details, and specifically under MSSHC Sec 01040.

2.2 Sand barrel attenuators

Sand barrel attenuators shall be manufactured from a frangible polyethylene material which shall shatter upon impact to permit dispersion of the sand mass contained within.

The outer container of the sand barrel attenuators shall be molded in one piece. The material shall be durable, weatherproof, and shall be formulated to resist deterioration from ultraviolet rays. The standard colors shall be yellow or gray. T11e sand barrel attenuator modules shall be of one piece continuous model construction and nest one within the other.

A cone-shaped supporting insert shall be provided which is varied to allow four different sizes of sand barrel attenuators to support 200, 400, 700, or 1400 pound sand masses. Care should be taken to fill each module with the proper amount of sand as called for by the manufacturer and in the array shown on the Plans.

Sand placed into these modules should be approved, washed concrete sand conforming to ASTM C-33.

A lid, which locks securely over the top of the outer container, shall be provided for each sand barrel attenuator. T'he material for this lid shall be durable, weatherproof, and shall be formulated to resist deterioration from ultraviolet rays.

The lid shall be capable of withstanding a 200 pound vertical load at the apex of the lid, at 68 degrees for at least 10 minutes without inverting. Lids shall be nested, one upon the other.

2.3 MISCELLANEOUS EQUIPMENT

2.4 CONCRETE

The concrete shall conform to Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

2.5 WELDING

Welding shall be in accordance with AWS D1.1.

2.6 PAVEMENT

After placement of the vehicle barrier or construction signs, the pavement sections shall be replaced to match the section and depth of the surrounding pavement. Pavement shall be match to the elevations of existing pavement. Positive surface drainage, away from the vehicle barrier, shall be provided by pavement slope.

2.7 SIGNS AND SIGN PANELS

All signs shall be fabricated on mild steel, aluminum, or of 5/8-inch or 3/4-inch, 5-ply, high-density type overlaid Douglas Fir plywood. Metal signs may be embossed borders or legends. All signs shall be fabricated to provide satisfactory structural rigidity.

Signage shall also conform to FHWA SA-89-006 sign (R12.2).

2.8 REFLECTORIZING

All signs shall have a reflectorized background, unless otherwise shown on the Plans. Reflective sheeting shall meet the requirements specified in the Missouri Highway and Transportation Commission "Standard Specification for Highway Construction, 1990," MODOT SEC 1042: HIGHWAY SIGN MATERIALS, TYPE 1.

2.9 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for roads, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturers instructions and approved plans.

3.2 Sand barrel attenuators

All sand barrel attenuators shall be installed as shown on the Plans, or as directed by the Contracting Officer's Representative. The height and diameter of the sand barrel attenuators shall be such to ensure that the center of gravity of each module is at the proper elevation to control the movement of the impacting vehicles, as specified by the manufacturer.

3.2.1 TEST CRITERIA

The sand barrel attenuators shall have been tested for head-on impacts per the procedures set forth in the National Cooperative Highway Research Program (NCHRP)Report 230. For impact vehicles weighing between 1,800 and 4,500 pounds, traveling at speeds of up to 60 MPH, the maximum 2 feet occupant flair space velocity shall be less than 40 ft/sec and the vehicle's highest 10 millisecond occupant ridedown acceleration shall be less than 20 G's.

Each sand barrel attenuator shall remain free from splitting. Each highway yellow color module shall remain within the limits of the FHWA highway yellow color.

3.3 Guard rail and guard cable CONSTRUCTION REQUIREMENTS

Guard rail and guard cable shall be placed at locations shown on the plans or designated by the Contracting Officer's Representative.

3.4 POSTS

Wood posts for Breakaway Cable Terminal (BCT) and end anchor shall be installed according to the plans.

Unless otherwise specified, wood posts shall be set in dug or bored holes, in a vertical position, and true to line and grade. Holes shall be of a size sufficient to permit thorough compacting of the backfill around the posts. The backfill material shall be dry sand, placed in layers not exceeding 12 inches thick to a height 12 inches below the finished grade. After erecting and adjusting the rail to true line and grade, the sand

backfill shall be compacted by flooding. The final 12 inches of backfill, consisting of suitable earth material, shall then be compacted in not more than 6-inch lifts. Surfaced area around the posts shall be restored to its former condition.

Steel posts may be set by the method described or may be driven by a power hammer. Any mushrooming of the top of a post shall be removed, and damaged spelter coating on galvanized posts shall be field repaired.

3.5 BEAMS

Beams shall be spliced by lapping in the direction of traffic. The use of 25-foot sections of beam rails, and channels if required, will be permitted for bridge anchor sections, and elsewhere where true line and grade can be maintained.

3.6 CABLE

Guard cable shall be strung directly from the reel and shall be pulled tight after the initial anchoring. The cable shall. then be attached to the second anchor assembly with all. turnbuckles fully opened. The cable shall be completely anchored before being attached to the line posts.

3.7 FIELD REPAIR

Galvanized material shall be handled in a manner to avoid damage to the surfaces. Field punching, reaming, or drilling of any of the galvanized materials shall not be done, except as may be approved by the engineer to provide for lapped beams, or for changes in location of splices necessitated by field clearances. Any galvanized material on which the spelter coating has been damaged will. be rejected or may, with approval of the engineer, be repaired by the zinc alloy stick method in accordance with MSSHC Sec. 712.

3.8 SCHEDULING

Unless a MODOT approved concrete traffic barrier is provided between the installed posts and the adjacent travel or auxiliary lane, and when that lane will be open to traffic during non-working hours, the contractor shall schedule guard rail and guard cable installation or replacement to assure that guard rail beam or guard cable is fully and properly attached to all installed posts at the end of each work day.

3.9 SURFACE PREPARATION

Pavements shall cure 30 days before marking. Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of

trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.9.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.9.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.9.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.10 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.10.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified . The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.10.1.1 Rate of Application

Non reflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.10.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.11 MARKING REMOVAL

Pavement marking, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.11.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.11.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

3.12 LEGEND AND BORDER PAINTING

The legend and border of all signs shall be painted by use of silk screen process, except that roller application for embossed legends or borders will be permitted. Paint shall be good quality, commercially available, stencil ink or paint. Free-hand painting will not be permitted.

Legends, dimensions, and colors shall be in accordance with the Plans and as directed by the Contractors licensed Missouri Professional Traffic Engineer.

3.13 CONSTRUCTION SIGNS CERTIFICATION

The Contractor shall furnish a manufacturer's certification , showing typical test results representative of the material and certifying that all materials supplied conform to all of the requirements specified. The Contractor shall also furnish the Engineer the fabricator's certification in triplicate stating "I hereby certify that only those materials conforming to Missouri Highway Transportation Department (MODOT) Standard Specifications, and FHWA SA-89-006 were used in the fabrication of the signs and the manufacturing processes used were in full compliance with the Specification requirements."

-- End of Section --

SECTION 02921

SEEDING
06/98

PART 1 GENERAL

Areas to be seeded are shown or defined in the project drawings., If more than one method of establishing seed is specified, drawings will delineate areas for each method.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01	(Aug 95) Federal Seed Act Regulations Part 201

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 2028	(1976; R 1992) Cutback Asphalt (Rapid-Curing Type)
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996) Standard Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "GA" designation or an "FIO" designation are for information only. When ysed, a designation following the "GA" designation identifies the office(s) that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA-RE . Surface Erosion Control Material; GA-RE . Chemical Treatment Material; GA-RE .

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

SD-07 Schedules

Equipment;GA-RE .

A listing of equipment to be used for the seeding operation.

SD-08 Statements

Delivery; GA-RE.

Delivery schedule.

Finished Grade and Topsoil; GA-RE.

Finished grade status.

Topsoil; GA-RE.

Availability of topsoil from the stripping and stock piling operation.

SD-09 Reports

Equipment Calibration; GA-RE.

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; GA-RE.

Results of soil test.

SD-13 Certificates

Seed; GA-RE. Topsoil; GA-RE. pH Adjuster; GA-RE. Fertilizer; GA-RE. Organic Material; GA-RE. Soil Conditioner; GA-RE. Wood Fiber Mulch/Tackifier; GA-RE. Mulch/Tackifier; GA-RE. Pesticide; GA-RE. Leguminous Inoculant; GA-RE.

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.

c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.

d. Fertilizer. Chemical analysis and composition percent.

e. Organic Material: Composition and source.

f. Soil Conditioner: Composition and source.

g. Wood Fiber Mulch/Tackifier: Composition and source.

i. Pesticide. EPA registration number and registered uses.

SD-14 Samples

Delivered Topsoil; GA-RE.

Samples taken from several locations at the source.

Soil Amendments; GA-RE.

A 10 pound sample.

Wood Fiber Mulch/Tackifier; GA-RE.

A 10 pound sample.

SD-18 Records

Quantity Check; GA-RE.

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; GA-PM-PR.

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described in written submittals and shown on appropriate project drawings.

Maintenance Record; GA-RE.

Maintenance work performed; areas repaired, reseeded or reestablished; diagnosis for unsatisfactory stand of grass plants.

Application of Pesticide; GA-RE.

Pesticide treatment plan with sequence of treatment, times, and rationale for application. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

1.2 AREAS

The unprotected finish surfaces and slopes of the random and impervious fill, and all disturbed construction areas, shall be seeded and mulched. Hillside/offsite borrow areas will not require seeding and mulching in excess of those measures in an approved Erosion Control Plan, unless the Contractor disturbs areas outside the established haul route and hillside excavation. Seeding and mulching of these areas will be performed by the Contractor at the Contractor's expense. Disturbed areas other than required for construction work shall be held to the minimum practicable to perform the work. Where areas are disturbed solely for the convenience of

the Contractor, as determined by the Contracting Officer's Representative (COR), such areas shall be seeded and mulched, and will be considered as protection of the environment.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in accordance with paragraph TOPSOIL. Soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, will be rejected. Other materials shall be inspected for compliance with specified requirements. The following will be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site and shall not be stored at the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Hydroseeding Time Limitation

The maximum hydroseeding time limitation for holding seed in a slurry shall be 12 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State certified seed is required for native grass and wildflower mixture, and preferred for the levee slope mixture. Seed shall be from the latest season's crop and shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. The Contractor shall furnish signed copies of statements from the suppliers, certifying that each container of seed delivered complies with specified requirements and is at least equal to the requirements specified herein. This certification shall be furnished on or with all copies of seed invoices. Each lot of seed will be tested by the COR and PM-PR, in accordance with the latest Rules and Regulations under the Federal Seed Act, at the discretion of the COR. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Seed Percentages and Required Descriptions

Seed mixtures shall be proportioned by seed count and seed count percentages. The seed counts and seed count percentages indicated per acre shall mean the total amount of pure live seed per acre for all species listed except forbs. At least 2 weeks prior to the time of seeding, the Contractor shall provide, for the approval of the COR, a written description of the grass and forbs seed and/or plant mix showing the percentage by number of seeds and/or plants of each species.

This description shall also include the following:

Name and location of seed and/or plant supplier;

Origin of the various species of seed. Wherever practical, the seed source shall be located within a 200-mile radius of the project site.

A statement of the purity of the grasses; and

The estimated number of seeds per pound of each of the kinds of seed to be furnished.

2.1.3 Seed Labeling

Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. Seeds and plants shall be true to their name as specified. Seed shall be furnished in sealed, standard containers, unless approved by the COR. Each lot of seed will be tested by the COR in accordance with the latest Rules and Regulations under the Federal Seed Act, at the discretion of the COR.

2.1.4 Seed Treatment, Storage, and Inspection Requirements

All legumes shall be inoculated with the proper rhizobia and at the

appropriate time prior to planting. All seeds shall be packed and covered in such a manner as to ensure adequate protection against damage and maintain dormancy while in transit or storage, or during planting operations. Seed that is wet or moldy or that has been otherwise damaged in transit or storage will not be acceptable, and shall be removed from the site.

2.1.5 Permanent Seed Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

2.1.5.1 Levee Slope Mixture

The levee slope mixture is to be used on levee slopes, on disturbed areas within 10 feet each side of the final levee slopes, and on all other areas as directed by the COR, with the exception of areas designated for seeding with the native grass and wildflower mixtures. The Levee Slope grass seed mixture shall consist of the following:

Kinds of Seed	Pounds Pure Live Seed/Acre
K-31 fescue (Festuca elatior)	50 lbs.
Domestic Ryegrass (Lolium perenne)	20 lbs.
Smooth brome (Bromus inermis)	30 lbs.
TOTAL POUNDS PURE LIVE SEED (PLS)/ACRE	100 lbs. PLS/ACRE

2.1.5.2 Native Grass Mixture B

The native grass seed mixture B is to be used on slopes and ponding areas and other wet areas such as ditches. Mixture B shall consist of the following:

Kinds of Seed	Pounds Pure Live Seeds/Acre
Grasses	
Big bluestem (Andropogon gerardii).....	4.50 lbs.
Virginia wildrye (Elymus virginicus).....	1.00 lbs.
Switchgrass (Panicum virgatum)(Var. Pathfinder)...	.50 lbs.
Indiangrass (Sorghastrum nutans).....	4.50 lbs.
Prairie cordgrass (Spartina spectinata).....	2.25 lbs.
Regreen Sterile Wheat (Triticum x agropyron).....	32.00 lbs.
TOTAL POUNDS PURE LIVE SEED/ACRE	**44.75 lbs. PLS/ACRE**

2.1.6 Temporary Seed Mixture/Cover Crop

The temporary seed mixture will be seeded on any areas brought to a temporary or final grade outside of the planting season that will not be finalized or revisited within 30 days of stoppage, completion or halting of activities.

Kinds of Seed	Pounds Pure Live Seeds/Acre
Sterile wheat	32.00 lbs.

2.1.7 Quality/Weed Seed Limit

Weed seed shall not exceed 0.5 percent by weight of the total of seed and other material in the mixture. be a maximum 1 percent by weight of the total mixture.

2.1.8 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.9 Seed Mixing

The mixing of seed shall be done by the seed supplier under the inspection of the Contracting Officer prior to delivery.

2.1.10 Substitutions

Substitutions will not be allowed without a written request and without written approval from both the Contracting Officer and from CENWK-PM-PR, (Environmental Resources Section, Planning Branch; Planning, Programs, and Project Management Division).

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02331 LEVEE CONSTRUCTION. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

2.3.2 Fertilizer

Commercial dry fertilizers used shall be complete fertilizers (e.g. 13-13-13). Such fertilizers shall be granular in texture and of controlled release (UF, 1BDU, SCU) type.

A slow-release type fertilizer of 18-46-6 grade, uniform in composition, free flowing and suitable for application with approved equipment, shall be provided. The fertilizer shall be delivered to the site in bags or other convenient containers, fully labeled or otherwise designated in accordance with applicable State fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer. Fertilizer may be supplied in bulk provided an analysis of samples tested in a laboratory is furnished for each shipment of fertilizer delivered to the project.

2.3.3 Organic Material

Organic material shall consist of either bonemeal, decomposed wood derivatives, or recycled compost.

2.3.3.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.3.2 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, yard trimmings, or other wood waste material that is free of stones, sticks, soil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.3.3.3 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The compost material shall not contain substances toxic to plants. Compost material shall possess a pH of 5.5 to 8.0, have a moisture content between 35-55 percent by weight, and be of a gradation such that it shall pass through a 10-mm 3/8-inch screen. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 2 inches in length.

2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Green sand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.4.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250 to 400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrite, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.3.4.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.3.4.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.4.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be prairie hay, or if prairie hay is not available, straw or cereal grain such as oats or wheat.

2.4.1 Hay

Hay shall be native hay, sudan-grass hay, or broomsedge hay, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.4.2 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.4.3 Wood Fiber Mulch

Wood fiber mulch, for use with the hydraulic application, shall consist of specially prepared wood fibers, dyed an appropriate color to facilitate visual metering of application of the materials. The wood fiber material shall have a composition, on an air-dry weight basis, between 9 to 15 percent moisture, with a pH range from 4.5 to 6.0. The wood fiber mulch

shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

The wood fiber mulch shall be manufactured so that after addition and agitation in slurry tanks with seeds, water, and any other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry. When hydraulically sprayed on the ground, the material shall form a blotter-like ground cover impregnated uniformly with seed, which, after application, will allow the absorption of moisture and allow rainfall or mechanical watering to percolate to the underlying soil. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished, and that their product meets all the requirements based upon such testing.

The mulch shall include a colloidal polysaccharide tackifier. The tackifier shall be adhered to the fibers during mulch manufacturing to prevent separation during shipment, and to avoid chemical agglomeration during mixing in the hydraulic mulching equipment. The tackifier shall comprise no less than 3% by weight of the total bulk weight of the packaged wood fiber mulch.

2.5 WATER

Water, for use in the hydraulic application of seeding, shall be free from oil, acid, alkali, salt, and other substances harmful to plant growth. Unless otherwise noted, the Contractor shall be responsible for obtaining all water sources. All water sources are subject to approval of the COR.

2.6 PESTICIDE

In this specification pesticide shall include any insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.7 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.7.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

2.7.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Surface Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch

square.

2.7.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.7.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.7.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PLANTING AND ESTABLISHING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

The levee cover seed mixture shall be planted from 1 March to 15 May for spring planting; and from 15 August to 1 October for fall planting, unless otherwise approved by the Contracting Officer.

3.1.1.1 Native Grass/Wildflower Mixture

Native grass/wildflower mixtures shall be planted from 1 April to 30 July .

3.1.1.2 Dormant Season Plantings

Dormant season plantings of levee seed mixture may occur from 15 December to 1 March. Dormant season plantings of the native grass/wildflower mixture may occur from 1 December to 31 March. The Contractor must establish a temporary cover crop or protect the seeded areas at the time any dormant season planting occurs. The Contractor shall be responsible for a satisfactory show of green as soon as conditions are favorable and shall be responsible for providing a satisfactory, established stand of the permanent seed mixtures after at least one growing season has occurred.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. Work shall be halted as directed when delays in operation extends the work beyond the most favorable planting season or when conditions are such by reason of drought, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained. Seeding operations shall be resumed only when conditions are favorable or when approved alternative or corrective measures and procedures have been effected. If delay of seeding is necessary, the finished slopes, berms and levee grade shall be temporarily protected with mulch. In addition, a temporary cover crop of sterile wheat will be seeded on disturbed areas if seeding delays will exceed 21 days. The temporarily protected area shall be cleaned of weeds and the slopes restored before seeding and mulching. If inspection during seeding and

mulching, or after there is shown of green, indicates that the areas have been left unplanted, additional seed shall be sown as directed.

3.1.3 Equipment Calibration

At least one week prior to seeding, calibration tests shall be conducted on the equipment to be used to determine or confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. Calibration test results shall be provided prior to seeding and within 1 week of testing. Calibration tests shall again be conducted on the equipment to be used immediately prior to the commencement of seeding operations. During the seeding operation, the equipment shall be calibrated a minimum of once every day.

3.1.4 Soil Tests

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. On-site sample collection shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The tests shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the topsoil placement, smooth grading, and compaction requirements have been completed in accordance with Section 02331 LEVEE CONSTRUCTION AND EARTHWORK, prior to commencement of the seeding operations.

3.2.2 Application of Fertilizer

Fertilizer of 18-46-6 grade shall be broadcast uniformly at a rate of 300 pounds per acre over areas to be seeded. If bulk fertilizer other than 18-46-6 grade is provided, the application rate shall be varied to obtain the quantity of nitrogen, phosphoric acid, and potash equivalent to that which would be provided with the specified rate for 18-46-6 grade.

3.2.3 Tillage

Soil on slopes up to a maximum 3 horizontal to 1 vertical shall be tilled to a minimum 2-inch depth. Rototillers shall be used where soil conditions and length of slope permit. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely loosened by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. Debris and stones over a minimum 3 inches in any dimension shall be removed from the surface.

3.2.4.2 Protection

Surface areas prepared for seeding shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION and ESTABLISHMENT

Prior to planting and establishing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of previous paragraph titled SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Seed Methods

Seeding method shall be drill seeding or hydroseeding. Seeding procedure shall ensure even coverage.

3.3.1.1 Drill Seeding

Seed shall be planted uniformly using a Truax-type, rangeland grass drill seeders capable of handling the native seed mixture. Half the total rate of seed application shall be broadcast in one direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction. Seed shall be covered a maximum 1/4 inch depth by soil packing/rolling device, cultipacker, or other approved device.

3.3.1.2 Hydroseeding

Seed and fertilizer shall be added to water and thoroughly mixed. Seed shall be held in the slurry for a maximum 12 hours. Wood fiber mulch with tackifier shall be added at the rate recommended by the manufacturer after the seed, fertilizer, and water have been thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.2 Mulching

3.3.2.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre, and shall be used to mulch the Levee Slope Mixture only . Mulch shall be spread by hand, with a blower-type mulch spreader, or by other approved method. Mulching shall start on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. Mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All seeded areas shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.3.2.2 Wood Fiber Mulch

Wood fiber mulch/tackifier shall be applied as part of the hydroseeding and hydromulching operation. The mulch shall be mixed according to the manufacturer's recommendation and applied at a rate of no less than 2000

pounds per acre. Wood fiber shall be used to mulch all areas seeded with native grasses and/or wildflowers. Hay/straw mulch shall not be used to mulch areas seeded with native grasses and/or wildflowers.

3.3.2.3 Mechanical Anchor

Mechanical anchoring of straw mulch shall be accomplished using a crimper; a V-type-wheel land packer; a disk with scallop-edged straight blades designed to force mulch into the soil surface; or other suitable equipment.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to temporary or permanent seed mixtures and without deviation to finished grade.

3.4.2 Temporary Seeding

As required in these specifications, when directed by the COR during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under paragraph SEED.

3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan identifing the pest and the area to be treated shall be submitted and coordinated with the COR.

3.6.1 Technical Representative

The Government's certified pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.6.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal

protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately. A pesticide plan shall be submitted.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved or gravelled areas shall be cleaned.

3.8 PROTECTION OF SEEDED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.9 SEED ESTABLISHMENT PERIOD

3.9.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of work under this contract and shall end six months after the last day of the seeding operation. Written calendar time period shall be furnished for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.9.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high. For areas other than levee slopes or the 10-foot wide bands immediately adjacent the levees, a satisfactory seeding operation must provide a stand of grasses, wildflowers, and forbs that has a minimum 20 plants per square foot. Total bare spots shall not exceed 1 percent of the total seeded area.

3.9.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting established/seeded areas from traffic; mowing; and post-fertilization.

3.9.3.1 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.3.2 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch or grasses, wildflowers, forbs and mulch, shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.9.3.3 Maintenance Record

A record of each site visit shall be furnished by the Contractor, describing the maintenance work performed; the areas repaired or reinstalled; and a diagnosis for the unsatisfactory stand of vegetation; a list of other actions necessary to obtain a satisfactory stand of vegetation; and timeframes for implementing corrections and follow-up inspections.

3.9.3.4 Additional Seeding

If an inspection conducted during seeding operations, or after there is a showing of green, indicates that areas have been left unplanted, additional seed shall be sown as directed.

3.9.4 Grass Drill Methods and Exception for Hydroseeding

The rangeland grass drill shall be used to install the permanent native grass mixture B at a depth of 1/4 inch. Where slopes, (3 horizontal to 1 vertical or greater) or permanently saturated soils prohibit the use of the rangeland grass drill, the hydroseeding method may be used with approval by the COR.

3.9.5 Hydroseeding/Hydromulching

The hydraulic seeding equipment shall include a pump rated and operated at no less than 100 gallons per minute and at no less than 100 pounds per square inch pressure. A minimum of 1,000 gallons of slurry (seed, water, fiber mulch) shall be used. The tank shall have a mechanical agitator powerful enough to keep all materials in a uniform suspension in the water. Ingredients shall be added for the application at the following rates:

(a) Seed as previously specified

(b) Wood fiber mulch at 2,000 lbs per acre

When hydroseeding the levee seed mixture and all other areas disturbed by construction operations other than area B, the Contractor shall incorporate sufficient fertilizer into the slurry to provide 1 lb of elemental nitrogen per 1,000 SF of seeded area. No fertilizer shall be utilized when reseeding the native grass and native grass and wildflower area B.

3.9.6 Seeding Times

3.9.6.1 Area with Mixture B

Seeding operations shall be between April 1st, or as soon thereafter as the soil is free of frost and in workable condition, and July 30th; and from December 1st to freeze-up (later if a no-till rangeland grass drill is

used). If using a no-till rangeland grass drill, planting can be done any time except from August 1st to December 1st. Wetlands are prohibited only from August 1st to November 1st.

3.9.6.2 Levee Slopes and Other Areas

All areas seeded with the levee slope seed mixture and all other areas disturbed by construction operations, other than Areas with Mixture B, shall be seeded between April 1 and May 15 for spring planting, and August 15 and October 1 for fall planting, unless otherwise approved by the COR and PM-PR.

3.9.7 Post Planting Management, Areas with Mixture B

If weeds infest newly seeded areas and shade the ground by 50 percent, the area shall be mowed to a height of 6 inches removing all clippings. Following the 1st anniversary of the installation, the area shall be mowed in early spring or late fall removing the clippings. Mowing times shall be as approved by the COR and PM-PR.

3.9.8 Protection and Maintenance of Levee Slope Mixture

The following maintenance shall begin immediately after planting of grass in the levee slope mixture, and shall continue until final acceptance.

3.9.9 Grass

Maintenance of grass cover shall consist of watering, weeding, cutting, repair of all erosion and reseeding as necessary to establish a uniform stand of the specified grasses, and shall continue until final acceptance. After the seeded grass has started, all of the areas greater than 12 inches square which fail to show a uniform stand of grass for any reason whatsoever, shall be reseeded until all areas are covered with a satisfactory growth of grass.

3.9.10 Cuttings/Mowings

When newly seeded grass reaches a height of 6 inches, the Contractor shall cut it back to 4 inches in height, and shall repeat the procedure for subsequent cuttings. After the second cutting, the Contractor shall top dress with specified fertilizer at a rate of 1/2 pound of elemental nitrogen from fertilizer per 1,000 sq ft.

3.10 GUARANTEE, AREAS with Mixture B

At the end of the third full growing season, not to exceed 36 months after seeding, a random sample of 20 percent of the area will be conducted. If 75 percent of the species planted are identified and the sample area has 80 percent coverage of acceptable species, the work will be accepted. If plant establishment was insufficient, the Contractor shall replant specified species at no cost to the Government.

-- End of Section --

SECTION 02945

TREE PROTECTION
12/99

PART 1 GENERAL

1.1 SCOPE

This Section describes/outlines protective measures to be taken to protect the trees and shrubs that are to remain in place from foliage, trunk, and root damages that may result from construction operations.

1.2 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 PROTECT TREES AND SHRUBS

The Contractor shall use all all due care to protect trees and shrubs that are to remain. The Contractor shall take all appropriate measures to avoid and prevent the following damages from occurring:

a. Compaction by equipment or material storage of soil areas near/above tree/shrub roots (anywhere within the trees' drip lines).

b. Trunk Damages to trees and shrubs resulting from contact with earth-moving and construction equipment, material storage, nailing or bolting, and other means.

c. Girdling / strangling / breakage of trees caused by tying ropes or guy wires to trunks or large branches.

d. Poisoning of trees and shrubs caused by pouring solvents, gas, paint, or other toxic substances or nonnative materials on or around tree trunks and/or roots.;

e. Cutting of tree or shrub roots by excavating, etching, etc;

f. Suffocation of tree/shrub roots due to placement of more than 4 inches of fill material on the surface within the drip line.

g. Damaged branches due to improper pruning and/or machinery operation.

h. Drought or disruption of water source resulting from failure to water or by cutting off / or changing normal drainage pattern past roots.

i. Changes of soil pH factor by disposal of lime base materials such as concrete, plaster, concrete waste water, etc.

3.1.2 PROTECTION OF TREE ROOTS.

The Contractor shall avoid/minimize the cutting of any tree/shrub roos and shall not cut tree or shrub roots that are 1-1/2 inches or greater in diameter. All excavation and earthwork within the drip line of trees shall be done by hand.

-- End of Section --

SECTION 02990

DETOUR AND HAUL ROAD
12/99

PART 1 GENERAL

This Section covers the construction of temporary detour and haul roads, including placement of temporary drainage pipe. The detour and haul roads shall be constructed as shown in the Drawings and as directed by the Contracting Officer's Representative (COR).

The Contractor shall use materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage or recycling, and conserve natural resources

1.1 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-04 Drawings

Plan of Operations; GA-RE.

Sequence of construction and recycling of materials plan.

1.4 Plan of Operations

The sequence of construction to be employed in placing operations and EM 385-1-1, requirements shall be submitted to the Contracting Officer's

Representative.

1.5 RECYCLING MATERIALS

All pavement and fill materials shall be recycled and incorporated into the levee system. The pavement and fill material quantities descriped below shall be deducted from the approprate bid schedule item covered in Section, LEVEE CONSTRUCTION AND EARTHWORK. All temporary drainage pipe shall be the property of the Contractor

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Acceptable Fill

Acceptable fill materials for the detour and haul roads shall meet requirements as specified in Section, LEVEE CONSTRUCTION AND EARTHWORK.

2.1.2 Acceptable Pavement

Acceptable pavement materials shall meet requirements as specified in Section, ASPHALTIC CONCRETE INTERMEDIATE LEVELING AND SURFACE COURSES (CENTRAL PLANT HOT MIX).

2.1.3 Pipe Material

Pipe material shall be shall be approved by the Contracting Officer's Representative prior to storgae or installtion on site. Placement of pipe materials and shall extend to the limits shown on the drawings or as directed by the Contracting Officer's Representative.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately prior to placing the pipe and fill materials, the underlying ground surface shall be prepared as required in Section, LEVEE CONSTRUCTION AND EARTHWORK.

3.2 OBLITERATION

Detour or haul roads sall be obliterated when no longer needed, but only after the corresponding portion of the new road has been opened to traffic. Obliteration shall include removal of culverts from the site and complete removal, reuse, stockpiling recycling, or burial of surfacing material, as well as all grading operations necessary to incorporate the temporary road into the final grading.

-- End of Section --

PHASE II

DIVISION 3 – CONCRETE

03101	Formwork for Concrete
03150	Expansion Joints, Contraction Joints, and Waterstops
03200	Concrete Reinforcement
03301	Cast-in-Place Structural Concrete for Civil Works
03330	Textured Color Admixture Concrete
03416	Precast Concrete

SECTION 03101

FORMWORK FOR CONCRETE
12/92

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 301	(1996) Standard Specification for Concrete
ACI 347R	(1994) Guide for Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31	(1994) Making and Curing Concrete Test Specimens in the Field
ASTM C 39	(1993a) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 1074	(1993) Estimating Concrete Strength by the Maturity Method
ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1983) Construction and Industrial Plywood

1.2 DESIGN REQUIREMENTS

The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. The formwork shall be designed for anticipated live and dead loads and shall comply with the tolerances specified in Section 03301 CAST-IN-PLACE STRUCTURAL CONCRETE, paragraph CONSTRUCTION TOLERANCES. However, for surfaces with an ACI Class A surface designation, the allowable deflection for facing material between studs, for studs between walers and walers between bracing shall be limited to 0.0025 times the span. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others, and placement and vibratory effects. The adequacy of formwork design and construction shall be

monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan. Formwork design shall conform to ACI 347R

Concrete specified elsewhere includes:
Section 02318, CONTROLLED LOW STRENGTH BACKFILL (FLOWABLE FILL).
Section 02754, CONCRETE PAVEMENTS FOR SMALL PROJECTS.
Section 03330, TEXTURED COLOR ADMIXTURE CONCRETE
Section 03416, PRECAST CONCRETE

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Materials; FIO-RE.

Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, and form coating

SD-04 Drawings

Shop Drawings; FIO-RE.

Drawings and design computations for all formwork required shall be submitted at least 30 days either before fabrication on site or before delivery of prefabricated forms.

SD-08 Statements

Shop Drawings; FIO-RE.

If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.

SD-09 Reports

Inspection; FIO-RE.

The Contractor shall submit field inspection reports for concrete forms and embedded items.

Formwork Not Supporting the Weight of Concrete; GA-RE.

If forms are to be removed in less than 24 hours on formwork not supporting the weight of concrete, the evaluation and results of the control cylinder tests shall be submitted to and approved before the forms are removed.

1.4 SHOP DRAWINGS

The shop drawings and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Forms and Form Liners

Forms and form liners shall be fabricated with facing materials that will produce a finish meeting the specified construction tolerance requirements and the following surface classifications as defined in ACI 347R.

2.1.1.1 Class "A" Finish

This class of finish shall apply to all exterior surfaces which will be esposed to view. The form facing material shall be composed of new, well-matched tongue-and-groove lumber or new plywood panels conforming to DOC PS 1, Grade B-B concrete form, Class I.

2.1.1.2 Class "C" Finish

This class of finish shall apply to formed surfaces which will not be exposed to public view or day light. Such as interior surfaces of gate wells and to all below grade exposed surfaces. The form facing may be either tongue-and-groove lumber, plywood, concrete form hard board or steel. Wood form facing for curved or warped surfaces shall be composed of splines of lumber which can be bent to the required shape without splitting or cracking.

2.1.1.3 Class "D" Finish

This class of finish shall apply to formed surfaces which are required to be permanently cover by backfill. The form facing may be of wood or steel.

2.1.2 Form Coating

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, the Contractor shall follow the recommendation of the form coating manufacturer.

2.2 ACCESSORIES

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either

exposed to view or exposed to water. Removable tie rods shall not be allowed in levee and levee structures and levee gatewell structures. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Form Construction

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. The Contractor shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class or classes specified in paragraph, "FORMS AND FORM LINERS" and tolerances specified in paragraph, "DESIGN REQUIREMENTS". Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

3.1.2 Chamfering

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminatedtwelve inches outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.1.3 Construction Joints.

Grade strips shall be used on all exposed horizontal construction joints so as to obtain a straight and neat true horizontal joint. A strip of one inch square-edged lumber, bevelled to facilitaie removal and oiled, shall be tacked to the inside of the forms at the construction joint. Concrete shall be palced to a point one inch above the understide of the strip. The strip shall be removed one hour after the concrete has been placed, any irregularties in the joint line leveled off with a wood float and all laitance removed.

3.1.4 Coating

Forms for exposed or painted surfaces shall be coated with form oil or a

form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.2 FORM REMOVAL

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum time, minimum ambient temperature, and minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed in accordance with ACI 347R Guide for Formwork for Concrete. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31 and ASTM C 39 at the expense of the Contractor by an independent laboratory that complies with ASTM C 1077 and shall be tested within 4 hours after removal from the site.

3.2.1 Formwork Not Supporting Weight of Concrete

Formwork for walls, columns, sides of beams, gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed. Form removal before 24 hours will be allowed for simple floor slab, sidewalks, and driveways provided the ambient temperature during this period has not fallen below 50 degrees F at any time since placement and evidence from compressive tests on field-cured concrete control cylinders indicates that the concrete has attained a compressive strength of at least 95% of design psi. Control cylinders shall be prepared for each set of forms to be removed before 24 hours. The stability of the concrete shall be evaluated by a structural engineer prior to removal of the forms.

3.2.2 Formwork Supporting Weight of Concrete

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders indicate evidence the concrete has attained at least 95% percent of the compressive strength required for the structure in accordance with the quality and location requirements of Section covering the application.

3.3 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

-- End of Section --

SECTION 03150

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS
05/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 111	(1983) Inorganic Matter or Ash in Bituminous Materials

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA ANSI/AHA A135.4	(1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 109	(1993) Steel, Strip, Carbon, Cold-Rolled
ASTM A 109M	(1991) Steel, Strip, Carbon, Cold-Rolled (Metric)
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 480/A 480M	(1996a) General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 152	(1994) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 152M	(1995) Copper Sheet, Strip, Plate, and Rolled Bar (Metric)
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM C 919	(1984; R 1992) Use of Sealants in Acoustical Applications
ASTM C 920	(1995) Elastomeric Joint Sealants

ASTM D 4	(1986; R 1993) Bitumen Content
ASTM D 6	(1995) Loss on Heating of Oil and Asphaltic Compounds
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM D 412	(1997) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1996) Rubber Property - Effect of Liquids
ASTM D 572	(1988; R 1994) Rubber - Deterioration by Heat and Oxygen
ASTM D 624	Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1190	(1996) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1191	(1984; R 1994) Test Methods for Concrete Joint Sealers
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1854	(1996) Specification for Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1855	(1989) Test Method for Jet-Fuel Resistant Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 2240	(1986) Rubber Property - Durometer Hardness (1991) Rubber Property - Durometer Hardness (1995) Rubber Property - Durometer Hardness
ASTM D 2628	(1991) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 1993) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D 5249	(1995) Backer Material for Use With Cold

and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

CORPS OF ENGINEERS (COE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Preformed Expansion Joint Filler; GA-RE. Sealant; GA-RE. Waterstops; GA-RE.

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-04 Drawings

Waterstops; GA-RE.

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-06 Instructions

Preformed Expansion Joint Filler; GA-RE. Sealant; GA-RE. Waterstops; GA-RE.

Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

SD-13 Certificates

Preformed Expansion Joint Filler; GA-RE. Sealant; GA-RE. Waterstops; GA-RE.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

SD-14 Samples

Preformed Compression Seals and Lubricants; GA-RE.

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample

shall be a piece not less than 9 ft of 1 inch nominal width or wider seal or a piece not less than 12 ft of compression seal less than 1 inch nominal width. One quart of lubricant shall be provided.

Field-Molded Type; GA-RE.

One gallon of field-molded sealant and one quart of primer (when primer is recommended by the sealant manufacturer) identified to indicate manufacturer, type of material, quantity, and shipment or lot represented.

Non-metallic Materials; GA-RE.

Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 12 inch long cut from each 200 ft of finished waterstop furnished, but not less than a total of 4 ft of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 12 inches long.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

Store hydrophilic waterstops in accordance with manufacturer recommendations. Hydrophilic waterstops shall be protected from oil, dirt, sunlight and premature exposure to sunlight

1.4 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1752 , Type 1. Unless otherwise indicated, filler material shall be 1/2 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.2 Rubber J-Seals

Rubber seals shall be of the molded type only, shall be compounded of natural rubber, synthetic polyisoprene or a blend of both and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents and plasticizers. Physical characteristics of the seals shall meet the following requirements:

Physical Test	Test Value	Test Method Specification
Tensile Strength	2500 psi (min.)	ASTM D 412
Elongation at Break	450% (min.)	ASTM D 412
300% Modulus	900 psi (min.)	ASTM D 412
Durometer Hardness (Shore Type A)	60 to 70	ASTM D 2240
Water Absorption	5% by weight (max.)	ASTM D 471
Compression Set	30% (max.)	ASTM D 395
Tensile Strength (After aging 48 hrs)	80% of tensile strength (min.)	ASTM D 572

The "Water Absorption" test shall be performed with distilled water. The washed specimen shall be blotted dry with filter paper or other absorbent material and suspended by means of small glass rods in the oven at a temperature of 70 degrees + 2 degrees C for 22 hours + 1/4 hour. The specimen shall be removed, allowed to cool to room temperature in air and weighed. The weight shall be recorded to the nearest 1 mg as W1 (W1 is defined in ASTM D 471). The immersion temperature shall be 70 degrees + 1 degree C and the duration of immersion shall be 166 hours.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

2.3.2 Lubricant for Preformed Compression Seals

ASTM D 2835.

2.3.3 Field Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 Flexible Metal

Stainless steel waterstops shall conform to ASTM A 167 and ASTM A 480/A 480M, UNS S30453 (Type 304L), and 20 gauge thick strip.

2.4.2 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic

elastomeric rubber waterstops shall conform to ASTM D 471.

2.5 Hydrophillic Waterstops

The material will be used at the construction joints on gatewells 2, 4, 4A, 7, 10 and 11.

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D 412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F shall be 3 to 1 minimum.

Hydrophillic Waterstops shall be dual extension waterstops, 10mm thickness by 30mm width. The Waterstop material shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophillic properties. The Waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

Physical Properties shall meet the following minimum requirements:

1. ASTM D 624 Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

2. ASTM D 2240 Hardness: 55 +/- 5 shore A.

3. Expansion ratio: Volumetric change in distilled water @ 20 degrees C, greater than 3 to 1.

Hydrophillic Waterstop Accessories.

All hydrophilic waterstop accessories be of the same manufacturer as the hydrophilic material and of type recommended by the hydrophilic manufacturer.

Provide a two component epoxy gel to secure the hydrophillic waterstop to concrete or steel. Provide a cyanacrylate adhesive at all waterstop joints and splices. Provide a hydrophillic sealant at all joints and splices.

2.6 WATERSEALS

1. Type: "Waterstop-RX Cold Joint Water Stop Volclay Waterproofing Systems" by American Colloid Company, "SynkoFlex Waterstop" by Synko-Flex Products, "Hydro-Flex Waterstop" by Henry Company, or equal.

2. Size: 1" x 1/2" (minimum)

3. Use: Where specifically shown.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a

steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints as indicated on the drawings and in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any

waterstops punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 Stainless Steel

Splices in stainless steel waterstops shall be welded using a TIG or MIG process utilizing a weld rod to match the stainless. All welds shall not be annealed to maintain physical properties. Carbon flame shall not be used in the annealing process. Damaged waterstops shall be repaired by removing damaged portions and patching. Patches shall overlap a minimum of 1 inch onto undamaged portion of the waterstop.

3.2.2 Flat Steel

Splices in flat steel waterstops shall be properly aligned, butt welded, and cleaned of excessive material.

3.2.3 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

3.2.3.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.3.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.3.3 End Openings

End openings of Type "Y" waterstops shall be plugged with a soft rubber plug furnished by the manufacturer, prior to the placement of concrete.

3.2.3.4 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than

1/16 inch. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joints deeper than 1/16 inch or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section, CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

3.4 Non-Metallic Hydrophilic Waterstop Installation

Install hydrophilic waterstops in accordance with approved manufacturer recommendations.

Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacrylate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

3.5 WATERSEALS

3.5.1 Cleaning

Clean joint surfaces to remove dirt, oil, grease, wax, and loose concrete and laitance.

3.5.2 Grout

Grout irregular surfaces to fill honeycomb or spalled areas.

3.5.3 Removal of Water

Remove water and allow concrete to become surface dry.

3.5.4 Waterseal Application

Apply waterseal directly to joint using primer or cut nails as required to securely adhere material to concrete surface.

3.5.5 Placement

Butt or lap together at ends and at intersections as recommended by manufacturer to keep continuous.

3.5.6 Waterseal Replacement

Waterseal contacted by water prior to placing concrete shall be removed and replaced with new waterseal if there is any evidence of swelling of material.

-- End of Section --

SECTION 03200

CONCRETE REINFORCEMENT
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary
ACI 315	Details and Detailing of Concrete Reinforcement

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 82	(1995a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1995b) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(1995) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1996) Epoxy-Coated Reinforcement Steel

Bars

ASTM A 884/A 884M (1996a) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1992) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1 (1996) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-04 Drawings

Concrete Reinforcement System; GA-RE.

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing. Complete shop drawings shall be submitted. The shop drawings shall be prepared under the direct supervision of a licensed professional engineer. The shop drawings shall contain his seal and a statement certifying that they are in compliance with the specifications and contract drawings. The shop drawing shall include details of the bending and placing schedule of the steel reinforcement, together with bar schedules indicating the number, size, dimensions, and total length of various bars required. Bar lists and bending diagrams shall be checked for accuracy and completeness before the bars are fabricated. Details of typical supports for reinforcing steel shall be approved prior to placing any concrete. Shop drawings shall show all concrete dimensions, location of all reinforcement, elevations, reinforcing steel clearances, and the location of all construction joints shown on the drawings or proposed by the Contractor. The drawings shall show support details including types, sizes and spacing. Spacing between vertical reinforcing steel shall be shown on the wall elevations. The minimum scale used in the shop drawings shall be 3/8-inch to the foot (1:50). Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-13 Certificates

Reinforcing Steel; FIO-RE.

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets

the requirements specified herein, prior to the installation of reinforcing steel.

1.3 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

1.4 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall be deformed bars and conform to ASTM A615/A615M, Grade 60, or ASTM A706/A706M, Grade 60. Smooth dowels for cradle joints are covered in Section, STORM DRAINAGE SYSTEM.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M, Grade 60 or ASTM A 706/A 706M, Grade 60, and sizes as indicated. ASTM A 706/A 706M shall be used for reinforcing steel welded to piles and all reinforcing steel which will be welded.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with ACI 315, ACI Detailing Manual and CRSI MSP-1, and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete supports on formed surfaces shall be wedge-shaped, not larger than 3-1/2x3-1/2 inches, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish

surfaces. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R and ACI 315 or as directed by the COR. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding will not be permitted. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Mechanical splices required for staged construction at closure monoliths shall be an approved threaded coupling, swaged sleeve or other positive connecting type. Materials for couplers, dowel bar splicer or sleeves shall be approved, and per manufacturer's written recommendations, meeting the requirements for ASTM A615, Grade 60. Splicers shall develop in tension at least 125 percent of the yield strength of the lapped reinforcing bars. Butt splices shall develop 125

percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.1.3 Hooks and Bends

Steel bars shall be mill or field-bent. All steel shall be bent cold unless authorized by the COR. No steel bars shall be bent after being partially embedded in concrete unless indicated on the drawings or authorized by the COR.

3.1.4 Placing Tolerances

3.1.4.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 1 inch.

3.1.4.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown on the drawings. The allowable variation for minimum cover shall be as follows:

Minimum Cover	Variation
8"	+1/2"
6"	+1/2"
4"	+3/8"
3"	+3/8"
2"	+1/4"
1-1/2"	+1/4"
1"	+1/8"
3/4"	+1/8"

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed at locations indicated. Dowels shall be accurately positioned and aligned before concrete placement. Dowels shall be rigidly supported during concrete placement.

-- End of Section --

SECTION 03301A

CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS
09/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 207	(1996) Mass Concrete
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1997) Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 229	(1994) Controlled Low Strength Materials (CLSM)
ACI 303R	(1991) Guide to Cast-in-Place Architectural Concrete Practice
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(1992; Rev 1992; Errata) Building Code Requirements for Reinforced Concrete
ACI 318M/318RM	(1995) Building Code Requirements for Structural Concrete and Commentary (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(2000) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999 ae1) Concrete Aggregates
ASTM C 39/C 39M	(1999) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(1999) Organic Impurities in Fine Aggregates for Concrete
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C 87	(1983; R 1995e1) Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	(1998) Lightweight Particles in Aggregate
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1978; R 1997) Clay Lumps and Friable Particles in Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 295	(1998) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 441	(1997e1) Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
ASTM C 494/C 494M	(1999a) Chemical Admixtures for Concrete

ASTM C 535	(1996e1) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 566	(1997) Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 595	(2000a) Blended Hydraulic Cements
ASTM C 597	(1983; R 1997) Pulse Velocity Through Concrete
ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 666	(1997) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 803/C 803M	(1997e1) Penetration Resistance of Hardened Concrete
ASTM C 805	(1997) Rebound Number of Hardened Concrete
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1260	(1994) Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM E 1155	(1996) Determining Floor Flatness and Levelness Using the F-Number System
ASTM E 1155M	(1996) Determining Floor Flatness and Levelness Using the F-Number System (Metric)

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 94	(1995) Surface Retarders
COE CRD-C 100	(1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 114	(1997) Test Method for Soundness of Aggregates by Freezing and Thawing of Concrete Specimens
COE CRD-C 130	(1989) Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 143	(1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate
COE CRD-C 318	(1979) Cloth, Burlap, Jute (or Kenaf)
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards

1.2 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.3 SUBMITTALS

Item numbers within submittal packages shall be clearly identified. Information, including letters, test results, and certifications, shall be presented with headings relevant to this project.

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES.

SD-08 Statements

Concrete Mixture Proportioning; GA-EC .

Requirements outlined in this paragraph shall be included in one transmittal. Concrete mixture proportions shall be determined by the Contractor, in accordance with the requirements in paragraphs, "MATERIALS" and "CONCRETE MIXTURE PROPORTIONING," and submitted for review. The concrete mixture quantities of all ingredients per cubicyard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Statements regarding cementious materials, aggregates, and chemical admixtures shall address all requirements specified. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag, and water; the mass of fine and coarse aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

Batch Plant; GA-EC .

The Contractor shall submit batch plant data to the Contracting Officer for review for conformance with applicable specifications.

Concrete Mixers; GA-EC .
Capacity; GA-RE.

The Contractor shall submit concrete mixer data which includes the make, type, and capacity of concrete mixers proposed for mixing concrete in conformance with the paragraphs, "CAPACITY" and "CONCRETE MIXERS."

Conveying Equipment and Methods; FIO-EC .

The conveying equipment and methods for transporting, handling, and depositing the concrete shall be submitted for review by the Contracting Officer for conformance with paragraphs, "CAPACITY" and "CONVEYING EQUIPMENT."

Placing Equipment and Methods; FIO-EC .

All placing equipment and methods shall be submitted for review by the Contracting Officer for conformance with paragraph, "CAPACITY."

The previous four submittals (Batch Plant, Concrete Mixers, Conveying Equipment, and Placing Equipment) shall be submitted in a single packet.

Testing Technicians; FIO-EC . Concrete Transportation Construction Inspector (CTCI); FIO-EC .

The Contractor shall submit statements that the concrete testing technicians and the concrete inspectors meet the requirements of paragraph, "TESTS AND INSPECTIONS."

Construction Joint Treatment; GA-EC .

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for review and approval for conformance with paragraph, "CONSTRUCTION JOINT TREATMENT."

Curing and Protection; GA-EC .

The curing medium and methods to be used shall be submitted for review and approval for conformance with paragraph, "CURING AND PROTECTION."

Cold-Weather Placing; GA-EC .

If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection meeting the requirements of paragraph, "COLD-WEATHER PLACING" shall be submitted for approval.

Hot-Weather Placing; GA-EC .

If concrete is to be placed under hot-weather conditions, the proposed materials and methods, meeting the requirements of paragraph, "HOT-WEATHER PLACING" and paragraph, "FINISHING," shall be submitted for review and approval.

The previous four submittals (Construction Joint Treatment, Curing and Protection, Cold-Weather Placing, and Hot-Weather Placing) shall be submitted in a single packet.

SD-09 Reports

Aggregate Quality; GA-EC .

Aggregate quality tests shall be submitted at least 30 days prior to start of concrete placement, in accordance with paragraph, "QUALITY OF AGGREGATES."

Uniformity of Concrete Mixing; GA-EC .

The results of the initial mixer uniformity tests as required in paragraph, "MIXER UNIFORMITY" shall be submitted at least 5 days prior to the initiation of placing.

Tests and Inspections; GA-EC .

Test results and inspection reports shall be submitted daily and weekly as required in paragraph, "REPORTS."

SD-13 Certificates

All certificates shall be submitted in a single packet.

Cementitious Materials; GA-EC

Cementitious Materials, including Cement and Pozzolan, and Ground Granulated Blast-Furnace Slag will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which they are furnished. Certification and

mill test reports shall be from samples taken from the particular lot furnished. No cementitious materials shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious materials will be subject to check testing from samples obtained at the source, at transfer points, or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

Impervious-Sheet Curing Materials; GA-EC

Impervious-Sheet Curing Materials shall be certified for compliance with all specification requirements.

Air-Entraining Admixture; GA-EC

Air-Entraining Admixture shall be certified for compliance with all specification requirements.

Other Chemical Admixtures; GA-EC

Other Chemical Admixtures shall be certified for compliance with all specification requirements.

Membrane-Forming Curing Compound; GA-EC

Membrane-Forming Curing Compound shall be certified for compliance with all specification requirements.

Epoxy Resin; GA-EC

Epoxy Resin Bonding Compound shall be certified for compliance with all specification requirements.

Nonshrink Grout; GA-EC .

Descriptive literature of the Nonshrink Grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered.

SD-14 Samples

Aggregates; GA-EC .

Samples of materials for government testing and approval shall be submitted as required in paragraph, "PRECONSTRUCTION SAMPLING AND TESTING."

1.4 GOVERNMENT TESTING AND SAMPLING

The Government will sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172.

1.4.1 Preconstruction Sampling and Testing

1.4.1.1 Aggregates

The aggregate sources listed at the end of this section for aggregates have been previously tested and at the time testing was performed were capable of producing materials of a quality required for this project provided suitable processing is performed. The Contractor may furnish materials from a listed source or from a source not listed. Coarse ggregates shall be produced from Burlington Limestone. Samples from any source of coarse aggregate and any source of fine aggregate selected by the Contractor, consisting of not less than 2000 pounds of each size coarse aggregate and 1500 pounds of fine aggregate taken under the supervision of the Contracting Officer in accordance with COE CRD-C 100 shall be delivered to the Corps of Engineer's Quality Control Labratory within 15 days after notice to proceed. (Unless otherwise directed, send the samples to the Corps Quality Control Labratory, located at 3909 Halls Ferry Road, Vicksburg, MS, 39180-6199, attention CEERD-GM-C. Telephone No. 601-634-3278). Sampling and shipment of samples shall be at the Contractor's expense. 90 days will be required to complete evaluation of the aggregates. Testing will be performed by and at the expense of the Government in accordance with the applicable COE CRD-C or ASTM test methods. The cost of testing one source for each size of aggregate will be borne by the Government. If the Contractor selects more than one source for each aggregate size or selects a substitute source for any size aggregate after the original source was tested, the cost of that additional testing will be borne by the Contractor. Tests to which aggregate may be subjected are listed in paragraph QUALITY. The material from the proposed source shall meet the quality requirements of this paragraph. Testing of aggregates by the Government does not relieve the Contractor of the requirements outlined in paragraph TESTS AND INSPECTIONS.

1.4.2 Construction Testing by the Government

Sampling and testing will be performed by and at the expense of the Government except as otherwise specified. No material shall be used until notice has been given by the Contracting Officer that test results are satisfactory.

1.4.2.1 Chemical Admixtures Storage

Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the Contractor when directed by the Contracting Officer and shall be rejected if test results are not satisfactory. Chemical admixtures will be accepted based on compliance with the requirements of paragraph, "CHEMICAL ADMIXTURES."

1.4.2.2 Concrete Strength

Compressive strength test specimens will be made by the Government and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than500 psi. A "test" is defined

as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including nondestructive testing, taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

a. Investigation of Low-Strength Test Results - When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803, or ASTM C 805 may be permitted by the Contracting Officer to estimate the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.

b. Testing of Cores - When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the performance of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement.

c. Load Tests - If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test shall be corrected in a manner satisfactory to the Contacting Officer. All investigations, testing, load tests, and correction of deficiencies will be performed and approved by the Contracting Officer at the expense of the Contractor, except that if all concrete is in compliance with the plans and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

1.5 DESIGN REQUIREMENTS

1.5.1 Concrete Strength

Specified compressive strength f'c shall be as follows:

COMPRESSIVE STRENGTH (PSI)	STRUCTURE OR PORTION OF STRUCTURE
4,000 @ 7 days	Pile cap at Q1 and Q3
4,000 @ 28 days	Remaining structures not listed above

1.5.2 Maximum Water-Cement (W/C) Ratio

Maximum W/C shall be 0.45 by mass. The W/C ratio may cause higher

strengths than that required by paragraph "Concrete Strength" of this section.

1.6 CONSTRUCTION TOLERANCES

1.6.1 General

The definitions of the terms used in the following tables shall be as defined in ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance controls. Tolerances shall not extend the structure beyond legal boundaries. Except as specified otherwise, plus tolerance increases the amount or dimension to which it applies, or raises a level alignment, and minus tolerance decreases the amount or dimension to which it applied, or lowers a level alignment. A tolerance without sign means plus or minus. Where only one signed tolerance is specified, there is no limit in the other direction. The application of the tolerances shall not be allowed to result in a reduction in the mininum required concrete clear cover over reinforcement or other metal embedment.

TOLERANCES FOR STRUCTURES (Includes Gatewells)

(1) Vertical alignment

For heights 100 feet or less

Lines, surfaces, and arrises..... 1 in

Outside corner of exposed corner columns and control joint grooves in concrete exposed. to view ..... 1/2 in

Sealing surfaces ..... 1/16 in

(2) Lateral alignment

In slabs, centerline location of openings 12 inches or smaller and edge location of larger openings ..... 1/2 in

Sawcuts, joints, and weakened plane embedment in slabs ..... 3/4 in

Sealing surfaces ..... 1/16 in

(3) Level alignment
Top of slabs

Elevation of slabs-on-grade ..... 3/4 in

Lintels, parapets, horizontal grooves, and other

lines exposed to view ..... 1/2 in

Sealing surfaces of sills and postwells.....1/16 in

(4) Cross-sectional dimensions
Members, such as abutments, postwells, pedestals, walls (thickness only), and slabs (thickness only)

12-in. dimension or less ..... +3/8 in
..... -1/4 in
More than 12 in. but not over 3 ft. dimension .... +1/2 in
..... -3/8 in
Over 3 ft. dimension ..... +1 in
..... -3/4 in
Dimensions of unformed members cast against soil
..... +3 in
..... -1/2 in

(5) Deviations from a planar surface measured with a 10-foot straight edge placed on high points:

General ..... 3/8 in
Sealing surface ..... 1/16 in

(6) The offset between adjacent pieces of formwork facing material shall not exceed:

Class A ..... 1/8 in
Class B ..... 1/4 in
Class C ..... 1/2 in
Class D ..... 1 in

TOLERANCES FOR TUNNEL LININGS, CONDUITS, PRECAST CONCRETE PIPE, FILLING AND EMPTYING CULVERTS AND INLET AND OUTLET STRUCTURES

(1) Lateral alignment

Centerline alignment

Water conveying, conduits, and culverts ..... 1/2 in

Others ..... 1 in

Inside dimensions ..... 0.005 times inside dimension

(2) Level alignment

Profile grade

Water conveying , conduits, and culverts 1/2in

Others ..... 1 in

Surface of invert ..... 1/4 in

Surface of side slope ..... 1/2 in

(3) Cross-sectional dimension

Thickness at any point

Conduits ..... +5 percent thickness but not less than 1/2 in.
..... -2.5 percent thickness but not less than 1/4 in.

1.6.2 Slabs on grade

Tolerances for finished surfaces of slabs on grade shall conform to the requirements specified herein, and in SECTION 02754 - CONCRETE PAVEMENTS FOR SMALL PROJECTS. The stricter tolerance requirement shall be used. Measurements shall be accomplished along the alignment of each paving direction (slabs on grade) for gates, railroad crossings, and street pavements. The measurements in the transverse direction shall be accomplished at slab joints and at 5-foot intervals along the alignment. Measurements in the longitudinal direction shall be accomplished continuously along the alignment at the centerline and edges of each paving lane or row of slabs. Measurements shall be accomplished across joints in slabs on grade to determine gradual and abrupt variations in surface elevations across joints.

1.6.3 Appearance

Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method that does not harm the concrete and that is approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall be portland cement, portland cement in combination with pozzolan or GGBF slag and shall conform to appropriate specifications listed below. Use of cementitious materials in architectural concrete shall be restricted to one color, one source, and one type.

2.1.1.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type I or II, except that the maximum amount of C3A in Type I cement shall be limited to a maximum of 15 percent, Type I and II shall meet the low alkali requirement. The same

types and source of Portland cement shall be used throughout the entire project. White Portland cement shall meet the above requirements, and may only be used when specifically approved in writing.

2.1.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III, with C3A limited to 8 percent, meeting the low alkali requirement may be used only when specifically approved in writing.

2.1.1.3 Pozzolan, Other than Silica Fume

Pozzolan shall conform to ASTM C 618, Class C or F, Tables 1 and 3, including the Supplementry Optional Chemical Requirements in Table 2 for available alkalies, and the Supplementary Optional Physical Reqirements in Table 4.

2.1.1.4 Ground Granulated Blast-Furnace Slag

Ground Granulated Blast-Furnace Slag shall conform to ASTM C 989, Grade 100 or 120.

2.1.2 Aggregates

2.1.2.1 General

Concrete aggregates may be furnished from any source capable of meeting the quality requirements as stated in paragraph QUALITY. Coarse aggregates shall be produced from Burlington limestone. The sources listed at the end of this section were previously evaluated and were found at that time capable of meeting the quality requirements when suitably processed. No guarantee is given or implied that any of the listed sources are currently capable of producing aggregates that meet the required quality stated in paragraph QUALITY. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size shall be as listed in paragraph NOMINAL MAXIMUM-SIZE COARSE AGGREGATE.

In addition to the grading limits in ASTM C 33, the fine aggregate, as delivered to the mixer shall have a fineness modulus of not less than 2.40 nor greater than 3.10. The grading of the fine aggregate shall also be controlled so that the fineness moduli of at least four of any five consecutive test samples of the fine aggregate as delivered to the mixer shall not vary more than 0.15 from the average fineness modulus of all samples taken during the first 30 days of concrete placement unless otherwise directed. The fineness modulus shall be determined by dividing by 100, the sum of the cumulative percentages retained on U.S. Standard Sieves Nos. 4, 8, 16, 30, 50, and 100. At the option of the Contractor, fine aggregate may be separated into two or more sizes or classifications, but the uniformity of grading of the separate sizes shall be controlled so that they may be combined throughout the job in fixed proportions established during the first 30 days of concrete placement.

2.1.2.2 Concrete Aggregate Sources

After the award of the contract, the Contractor shall designate in writing only one source or combination of sources from which he proposes to furnish

aggregates. If the Contractor proposes to furnish aggregates from a source or from sources not listed at the end of this section, he may designate only a single source or single combination of sources for aggregates. Regardless of the source, selected samples for acceptance testing shall be provided as required by paragraph GOVERNMENT TESTING AND SAMPLING. If a source for coarse or fine aggregates so designated by the Contractor does not meet the quality requirements stated in paragraph QUALITY, the Contractor may not submit for approval other non-listed sources but shall furnish the coarse or fine aggregate, as the case may be, from sources listed at the end of this section at no additional cost to the Government.

2.1.2.3 Quality

Fine aggregates shall conform to the aggregate quality requirements of ASTM C 33, except as modified herein. Coarse aggregates shall conform to the aggregate quality requirements of ASTM C 33, Class 5S, except as modified herein. Aggregate particles shall be sound and durable and free from objectionable coatings. Coarse agggregate shall not contain more than 0.5 percent by weight of white tripolitic chert that has a specific gravity, saturated surface dry, of less than 2.40. Tripolitic chert is the white porous siliceous form of weathered chert found in nodules and beds within some Burlington limestone sources. The total amount of all types of chert shall not exceed 3 percent by weight. To keep chert from exceeding these specified maximum limits, it may be necessary to employ selective quarrying to utilize the lesser cherty portions of the limestone deposit and to remove cherty particles by processing, loading, and handpicking from the quarried material before and during final processing into finished aggregate sizes.

Aggregates shall have a specific gravity, saturated surface dry of not less than 2.60, and an absorption of not more than 2.0 percent, as determined by ASTM C 127and ASTM C 128. The aggregates shall be tested in accordance with ASTM C 1260 and shall have an expansion of lesss than 0.1 percent at 16 days.

In addition, aggregates delivered to the mixer shall meet the following requirements:

PROPERTY TEST	TEST LIMITS FINE AGGREGATE	COARSE AGGREGATE	
Durability Factor using (Procedure A)	Greater than 50	Greater than 50	COE CRD-C 114 ASTM C 666
Clay Lumps and Friable Particles	1	2	ASTM C 142
Material Finer than 75-µm (No. 200) Sieve	3	1	ASTM C 117
Organic Impurities	Not darker than No. 3		ASTM C 40
	Not less than 95 percent		ASTM C 87
Test Limits L.A. Abrasion		40	ASTM C 131 ASTM C 535

PROPERTY TEST	TEST LIMITS FINE AGGREGATE	COARSE AGGREGATE	
Total Lignite	0.1		ASTM C 123
Total Chert, than less 2.40 specific gravity		0.5	ASTM C 123

PROPERTY TEST	TEST LIMITS FINE AGGREGATE	COARSE AGGREGATE	
Coal and Lignite, less than 2.00 specific gravity	0.25	0.25	ASTM C 123
Petrographic Examination	Presence and types of Chert, Coal, Lignite, Shale and Alkali-Silica reactive aggregates		ASTM C 295

2.1.2.4 Particle Shape

The shape of the particles in the fine aggregate and in the coarse aggregate shall be generally spherical or cubical. The quantity of flat and elongated particles in the separated size groups of coarse aggregate, as defined and determined by CE specification CRD-C 119 shall not exceed 25 precent in any size group.

2.1.3 Chemical Admixtures

Chemical admixtures to be used, when required or permitted, shall conform to the appropriate specification listed.

2.1.3.1 Air-Entraining Admixture

The air-entraining admixture shall conform to ASTM C 260 and shall consistently cause the concrete to have an air content in the specified ranges under field conditions.

2.1.3.2 Accelerating Admixture

Accelerators shall meet the requirements of ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.1.3.3 Water-Reducing or Retarding Admixture

a. Water-Reducing or Retarding Admixtures: ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

b. High-Range Water Reducing Admixture: ASTM C 494/C 494M, Type F or G except that the 6-month and 1-year strength requirements shall be waived. The admixture may be used only when approved by the Contracting Officer, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan.

2.1.3.4 Other Chemical Admixtures

Other chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type 1 or 2. These admixture shall be used only for concrete listed in paragraph SLUMP.

2.1.4 Curing Materials

2.1.4.1 Impervious-Sheet Curing Materials

Impervious-sheet curing materials shall conform to ASTM C 171, type optional, except polyethylene film shall not be used.

2.1.4.2 Membrane-Forming Curing Compound

The membrane-forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, coating, or flooring specified. Nonpigmented compound shall contain a fugitive dye and shall have the reflective requirements in ASTM C 309 waived.

2.1.4.3 Burlap

Burlap used for curing shall conform to COE CRD-C 318.

2.1.5 Water

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, alkali, or organic compounds, except that nonpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.6 Nonshrink Grout

Nonshrink grout shall conform to ASTM C 1107 and shall be a commercial formulation suitable for the application proposed.

2.1.7 Epoxy Resin

Epoxy resin for use in repairs shall conform to ASTM C 881, Type III, Grade I or II.

2.2 CONCRETE MIXTURE PROPORTIONING

2.2.1 Quality of Mixture

For each portion of the structure, mixture proportions shall be selected so that the strength and W/C requirements listed in paragraph DESIGN REQUIREMENTS are met.

2.2.2 Cement Content

Cement Content shall be measured by weight. Cement content per cubic yard of concrete shall be 564 pounds, minimum.

2.2.3 Aggregate

The aggregate portion of the concrete mixtures shall contain at least 50 percent crushed Burlington limestone coarse aggregate.

2.2.4 Nominal Maximum-Size Coarse Aggregate

Nominal maximum-size coarse aggregate shall be 3/4 inch. .

2.2.5 Air Content

Air content as delivered to the forms and as determined by ASTM C 231 shall be between between 4-1/2 and 7-1/2 percent.

2.2.6 Slump

The slump shall be determined in accordance with ASTM C 143/C 143M and shall be within the range of 1 to 4 inch. Where placement by pump is approved, the slump shall not exceed 6 inches. The slump of pumped concrete shall be determined at the discharge side of the pump. Controlled Low Strength Material (CLSM) may contain a chemical admixture for use in producing a flowable concrete mixture in accordance with ASTM C 1017/C 1017M. The slump of flowable concrete shall not exceed 8-inches.

2.2.7 Concrete Proportioning

Trial batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of materials other than aggregate shall be representative of those proposed for the project and shall be accompanied by the manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios, which will produce a range of strength encompassing those required for the work. The maximum water-cement ratios required in paragraph MAXIMUM WATER-CEMENT RATIO will be converted to a weight ratio of water to cement plus pozzolan by mass, or GGBF slag by mass equivalency as described in ACI 211.1. In the case where GGBF slag is used, the weight of the slag shall be included in the equations for the term P, which is used to denote the mass of pozzolan. If pozzolan (Fly Ash)is used in the concrete mixture, the pozzolan content shall be 20 percent of the total cementitious material. Trial mixtures shall be proportioned for maximum permitted slump and air content with due consideration to the approved conveying and placement method. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 days and at the design age specified in paragraph DESIGN REQUIREMENTS in accordance with ASTM C 39/C 39M. From these test results, a curve will be plotted showing the relationship between water-cement ratio and strength.

2.2.8 Required Average Compressive Strength

In meeting the strength requirements specified in paragraph CONCRETE STRENGTH, the selected mixture proportion shall produce a required average compressive strength f'cr exceeding the specified strength f'c by the amount indicated below.

2.2.8.1 Average Compressive Strength from Test Records

Where a concrete production facility has test records, a standard deviation

shall be established in accordance with the applicable provisions of ACI 214. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified strength or strengths (f'c) within 1,000 psi of that specified for proposed work, and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another test age designated for determination of f'c.

Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'cr = f'c + 1.34S$$
$$f'cr = f'c + 2.33S - 500$$

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS*	MODIFICATION FACTOR FOR STANDARD DEVIATION Use tabulation in paragraph DETERMINING REQUIRED AVERAGE STRENGTH
less than 15	
15	1.16
20	1.08
25	1.03
30 or more	1.00

*Interpolate for intermediate numbers of tests.

2.2.8.2 Average Compressive Strength without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength fcr shall be determined as follows:

If the specified compressive strength f'c is less than 3,000 psi,

$$f'cr = f'c + 1,000 \text{ psi}$$

If the specified compressive strength f'c is 3,000 to 5,000 psi,

$$f'cr = f'c + 1,200 \text{ psi}$$

If the specified compressive strength f'c is over 5,000 psi,

$$f'cr = f'c + 1,400 \text{ psi}$$

PART 3 EXECUTION

3.1 EQUIPMENT

3.1.1 Capacity

The batching, mixing, conveying, and placing equipment shall have a capacity of at least 40 cubic yards per hour.

3.1.2 Batch Plant

Batch plant shall conform to the requirements of NRMCA CPMB 100and as specified; however, rating plates attached to batch plant equipment are not required. The batch plant may be located on or off the project site.

3.1.2.1 Batching Equipment

The batching controls shall be semiautomatic or automatic. The semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with an accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. Separate bins or compartments shall be provided for each size group of aggregate and cement, pozzolan, and GGBF slag. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cement, pozzolan, or GGBF slag. If both cement and pozzolan or GGBF slag are used, they may be batched cumulatively provided that the portland cement is batched first. If measured by mass, the mass of the water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Admixtures shall not be combined prior to introduction in water. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment. All filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.1.2.2 Scales

The equipment for batching by mass shall conform to the applicable requirements of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. Tests shall be made at the frequency required in paragraph TESTS AND INSPECTIONS, and in the presence of a government inspector.

3.1.2.3 Batching Tolerances

a. Weighing Tolerances

MATERIAL	PERCENT OF REQUIRED MASS
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2

MATERIAL	PERCENT OF REQUIRED MASS
Water	plus or minus 1
Chemical admixture	0 to plus 6

b. Volumetric Tolerances - For volumetric batching equipment, the following tolerances shall apply to the required volume of material being batched:

Water: ..... Plus or minus 1 percent.
Chemical admixtures: ..... Zero to plus 6 percent.

3.1.2.4 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the masses of the materials being batched. An electric moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measuring moisture in the fine aggregate. The sensing element shall be arranged so that the measurement is made near the batcher charging gate of the sand bin or in the sand batcher.

3.1.3 Concrete Mixers

The concrete mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.1.3.1 Stationary Mixers

Concrete plant mixers shall be tilting, nontilting, horizontal-shaft, vertical-shaft, or pugmill and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.1.3.2 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

3.1.4 Conveying Equipment

The conveying equipment shall conform to the following requirements.

3.1.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at

least five times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.1.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.1.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment may be used for transporting plant-mixed concrete over a smooth road when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.1.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.1.4.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant trunk that is long enough to extend through the reinforcing bars.

3.1.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.1.5 Vibrators

Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed in conformance with the following requirements:

APPLICATION	HEAD DIAMETER INCHES	FREQUENCY VPM	AMPLITUDE INCHES
Thin walls, beams, etc.	1-1/4 to 2-1/2	9,000 to 13,500	0.02 to 0.04
General construction	2 to 3-1/2	8,000 to 12,000	0.025 to 0.05

The frequency and amplitude shall be determined in accordance with COE CRD-C 521.

3.2 PREPARATION FOR PLACING

3.2.1 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding, including tack welding, will not be permitted on embedded metals within 2 feet of the surface of the concrete.

3.2.2 Concrete on Earth Foundations

Earth surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the earth foundation shall have been satisfactorily compacted in accordance with Section 02331 - EARTHWORK.

3.2.3 Concrete on Rock Foundations

Rock surfaces upon which concrete is to be placed shall be clean, free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached, or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, all rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as described in paragraph CONSTRUCTION JOINT TREATMENT. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon. All approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. The mortar shall be covered with concrete before the time of initial setting of the mortar.

3.2.4 Construction Joint Treatment

Construction joint treatment shall conform to the following requirements.

3.2.4.1 Joint Preparation

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Air-water cutting will not be permitted on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean, well bonded coarse aggregate is exposed uniformly throughout the lift surface. The edges of the coarse aggregate shall not be undercut. The surface shall be washed clean again as the last operation prior to placing the next lift. There shall be no standing water on the surface upon which concrete is placed.

3.2.4.2 Air-Water Cutting

Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 90 to 110 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift to prolong the period of time during which air-water cutting is effective. Prior to receiving approval, the Contractor shall furnish samples of the material to be used and shall demonstrate the method to be used in applications. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure water jet or sandblasting will be required as the last operation before placing the next lift.

3.2.4.3 High-Pressure Water Jet

A stream of water, under a pressure of not less than 3,000 psi, may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.2.4.4 Wet Sandblasting

This method may be used when the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. The surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.2.4.5 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.3 PLACING

3.3.1 Placing Procedures

The surfaces of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing

concrete. Surfaces may be dampened immediately before placement if necessary. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation. Concrete shall be deposited as close as possible to its final position in the forms and, in so depositing, there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it may be effectively consolidated in horizontal layers 2.0 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed. Concrete shall be placed by methods that will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper that is conical in shape. The concrete shall not be dropped vertically more than 5 feet, except where a properly designed and sized elephant truck with rigid drop chute bottom section is provided to prevent segregation and where specifically authorized. In no case will concrete be discharged to free-fall through reinforcing bars.

3.3.2 Placement by Pump

When concrete is to be placed by pump, the nominal maximum-size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms. Grout used to lubricate the pumping equipment at the beginning of the placement will not be incorporated into the placement.

3.3.3 Time Interval Between Mixing and Placing

Concrete shall be placed within 30 minutes after discharge into nonagitating equipment. When concrete is truck-mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work, and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregates. When the length of haul makes it impossible to deliver truck-mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site.

3.3.4 Cold-Weather Placing

When cold-weather placing of concrete is likely to be subjected to freezing temperatures before the expiration of the curing period, it shall be placed in accordance with procedures previously submitted in accordance with paragraph SUBMITTALS. The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32 degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 and 75 degrees F when measured in accordance with ASTM C 1064/C 1064M. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete-placing temperatures. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt,

chemicals, or other materials shall not be mixed with the concrete to prevent freezing. Concrete placements with a least dimension of 2.5 feet shall be protected from damaging thermal gradients and temperature conditions as recommended in ACI 207, except as otherwise specified or directed.

3.3.5 Hot-Weather Placing

Concrete shall be properly placed and finished with procedures previously submitted in accordance with paragraph SUBMITTALS. The concrete-placing temperature shall not exceed 85 degrees F when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph WATER-REDUCING OR RETARDING ADMIXTURES may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature. Concrete palcements with a least dimension of 2.5 feet shall be protected from damaging thermal gradients and temperature conditions as recommended in ACI 207, except as otherwise specified or directed.

3.3.5.1 Large Placements

The concrete placing temperature, for placements with a least dimension of 2.5 feet shall be less than 70 degrees F. The temperature determination shall be made in the freshly placed concrete. Shaved ice may be used to replace a portion of the mixing water requirement on a direct weight substitution basis. Liquid nitrogen injection in the mixer may also be used. Methods of temperature control proposed for use in hot weather concreting shall be submitted for approval.

3.3.6 Consolidation

Immediately after placement, each layer of concrete, including Controlled Low Strength Material (CLSM) and flowable fill concrete, shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required, if necessary, with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used unless specifically approved. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding unhardened layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly.

3.3.7 Placing Concrete Underwater

Concrete, used to seal the concrete caisions and other placements required in water, shall be deposited in water by a tremie or concrete pump. The methods and equipment used shall be subject to approval. Concrete buckets will not be permitted for underwater placement of concrete except to deliver concrete to the tremie. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end of the pump line or tremie shaft shall be kept continuously submerged in the concrete. The underwater seal shall be effected in a manner that will not

produce undue turbulence in the water. The tremie shaft shall be kept full of concrete to a point well above the water surface. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow will be limited to 15 feet.

3.4 FINISHING

The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 40 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour. Provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish. Additional finishing shall be as specified below and shall be true to the elevation shown in the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown in the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or jitterbugs shall not be used.

3.4.1 Unformed Surfaces

3.4.1.1 Float Finish

All unformed surfaces shall be screeded and darbied or bullfloated to bring the surface to the required finish level with no coarse aggregate visible. No water, cement, or mortar shall be added to the surface during the finishing operation. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power-driven equipment. Hand floats shall be made of magnesium or aluminum.

3.4.1.2 Trowel Finish

A trowl finish shall be applied to unformed surfaces where indicated. Concrete surfaces shall be finished with a float finish, and after surface moisture has disappeared, the surface shall be troweled to a smooth, even, dense finish free from blemishes including trowel marks.

3.4.1.3 Broom Finish

A broom finish shall be applied as the final surface texturing for slabs on grade which will be subject to vehicle or pedestrian traffic. The concrete surface shall be given a float finish. The floated surface shall be broomed with a fiber-bristle brush in a direction transverse to that of the main traffic

3.4.2 Formed Surfaces

Unless another finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired as

described in paragraph FORMED SURFACE REPAIR. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. The finished surface of textured, tooled, and other archetectural finishes shall duplicate the preapproved sample panel. The sample panel shall be prepared in accordance with Section 03101 FORMWORK FOR CONCRETE. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

3.4.2.1 Textured Finish

Textured finish shall be applied where specified or indicated, unless otherwise directed. This type of finish shall be applied where specified to conform to details shown in the drawings by use of approved textured form liners. Liner panels shall be secured in the forms by methods recommended by the manufacturer but not by methods that will permit impressions of nail heads, screw heads, washers, or the like to be imparted to the surface of the concrete. Edges of textured panels shall be sealed to each other to prevent grout leakage. The sealant used shall be nonstaining to the surface. The finish shall be similar to and shall closely match the finish on the sample panel.

3.4.2.2 Tooled Finish

Tooled finish shall be applied where specified or indicated, unless otherwise directed. The thoroughly cured concrete shall be dressed with electric, air, or hand tools to a uniform texture and shall be given a hand-tooled surface texture. The finish shall be similar to and shall closely match the finish on the sample panel.

3.4.3 Formed Surface Repair

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

3.4.3.1 Class A Finish

Surfaces listed in Section 03101 FORMWORK FOR CONCRETE and as shown to have a class A finish shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 16 square inches in area and less than 1/2 inch deep and bug holes exceeding 1/2 inch in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph MATERIAL AND PROCEDURE FOR REPAIRS. Defective and unsound concrete areas larger than described shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

3.4.3.2 Class C and Class D Finishes

Surfaces listed in Section 03101 FORMWORK FOR CONCRETE and as shown shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 24 square inches and less than 2 inches deep; bug holes exceeding 1-1/2 inches in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar. Defective and unsound concrete areas larger than 24 square inches and deeper than 1-1/2 inches shall be defined by 1/2 inch deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS.

3.4.3.3 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Contracting Officer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 40 degrees F during placement, finishing, and curing. Other methods and materials for repair may be used only when approved in writing by the Contracting Officer. Repairs of the so called "plaster-type" will not be permitted.

3.5 CURING AND PROTECTION

3.5.1 Duration

All concrete shall be cured by an approved method. Curing effectiveness and methods shall be continuously maintained to ensure that concrete curing is uninterrupted for the entire curing period.

Concrete produced with Type I or III Portland cement shall be cured for at least 7 days.

Concrete containing Type II Portland cement, or fly ash shall be cured for at least 14 days.

Concrete containing GGBF slag shall be cured for at least 21 days.

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, and mechanical damage. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to the start of concrete placement. Concrete shall be protected from the damaging effects of rain for 12 hours and from flowing water for 14 days. No fire or excessive heat including welding shall be permitted near or in direct contact with concrete or concrete embedments at any time.

3.5.2 Moist Curing

Moist-cured concrete shall be maintained continuously, not periodically, wet for the entire curing period. If water or curing materials stain or discolor concrete surfaces that are to be permanently exposed, they shall be cleaned as required in paragraph APPEARANCE. Where wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. Where steel forms are left in place during curing, the forms shall be carefully broken loose from the hardened concrete and curing water continuously applied into the void so as to continuously saturate the entire concrete surface. Horizontal surfaces may be moist cured by ponding, by covering with a minimum uniform thickness of 2 inches of continuously saturated sand, or by covering with saturated nonstaining burlap or cotton mats. Horizontal construction joints may be allowed to dry for 12 hours immediately prior to the placing of the following lift.

3.5.3 Membrane-Forming Curing Compound

Concrete may be cured with an approved membrane-forming curing compound in lieu of moist curing except that membrane curing will not be permitted on any surface to which a grout-cleaned finish is to be applied or other concrete is to be bonded, on any surface containing protruding steel reinforcement, on an abrasive aggregate finish, or any surface maintained at curing temperature by use of free steam. A styrene acrylate or chlorinated rubber compound may be used for surfaces that are to be painted or are to receive bituminous roofing or waterproofing, or for floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified.

3.5.3.1 Pigmented Curing Compound

A pigmented curing compound meeting the requirements of the above paragraph MEMBRANE-FORMING CURING COMPOUND may be used on surfaces that will not be exposed to view when the project is completed.

3.5.3.2 Nonpigmented Curing Compound

A nonpigmented curing compound containing a fugitive dye may be used on surfaces that will be exposed to view when the project is completed. Concrete cured with nonpigmented curing compound must be shaded from the sun for the first 3 days when the ambient temperature is 90 degrees F or higher.

3.5.3.3 Application

The curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. The surfaces shall be thoroughly moistened with water, and the curing

compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared and bleeding has stopped. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces that have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other cause that will disrupt the continuity of the curing membrane.

3.5.4 Evaporation Retardant

Sheet curing shall not be used on vertical or near-vertical surfaces. All surfaces shall be thoroughly wetted and be completely covered with waterproof paper or polyethylene-coated burlap having the burlap thoroughly water-saturated before placing. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.5.5 Cold-Weather Curing and Protection

When the daily outdoor low temperature is less than 32 degrees F, the temperature of the concrete shall be maintained above 40 degrees F for the first 7 days after placing. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by observation of ambient and concrete temperatures indicated by suitable temperatures measuring devices furnished by the Government as required and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor at such locations as may be directed.

3.5.6 Hot Weather Curing and Protection

When the rate of evaporation of surface moisture, as determined by use of Fig. 2.1.5 of ACI 305, may reasonably be expected to exceed 0.2 pounds per square foot per hour, provisions for windbreaks, shading, fog spraying, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

3.6 SETTING OF BASE PLATES AND BEARING PLATES

3.6.1 Setting of Plates

After being plumbed and properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and

equipment base plates shall be provided with full bearing with nonshrink grout. The space between the top of concrete or masonry-bearing surface and the bottom of the plate shall be approximately 1/24 of the width of the plate, but not less than 1/2 inch for plates less than 12 inches wide. Concrete surfaces shall be rough, clean, and free of oil, grease, and laitance, and they shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust.

3.6.2 Nonshrink Grout Application

Nonshrink grout shall conform to the requirements of paragraph NONSHRINK GROUT. Water content shall be the minimum that will provide a flowable mixture and fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.6.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or masonry-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for retaining the grout and shall be removed after the grout has set. If grade "A" grout as specified in ASTM C 1107 is used, all surfaces shall be formed to provide restraint. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.6.2.2 Treatment of Exposed Surfaces

After the grout has set, those types containing metallic aggregate shall have the exposed surfaces cut back 1 inch and immediately covered with a parge coat of mortar proportioned by mass of one part portland cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of nonshrink grout shall have a smooth, dense finish.

3.6.2.3 Curing

Grout and parge coats shall be cured in conformance with paragraph CURING AND PROTECTION.

3.7 TESTS AND INSPECTIONS

Tests and inspections shall conform to the following requirements.

3.7.1 General

The Contractor shall perform the inspections and tests described below, and, based upon the results of these inspections and tests, he shall take the action required and submit reports as required. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease. The laboratory performing the tests shall

conform with ASTM C 1077. The laboratory shall be located onsite. (An offsite laboratory may be used, subject to the approval of the Contracting Officer.) The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I. The individuals who perform the inspection of concrete construction shall have demonstrated a knowledge and ability equivalent to the ACI minimum guidelines for certification of Concrete Transportation Construction Inspector (CTCI). The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per year thereafter for conformance with ASTM C 1077.

3.7.2 Testing and Inspection Requirements

3.7.2.1 Fine Aggregate

a. Grading - At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each size range of fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

b. Corrective Action for Fine Aggregate Grading - When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer.

c. Moisture Content Testing - When in the opinion of the Contracting Officer the electric moisture meter is not operating satisfactorily, there shall be at least four tests for moisture content in accordance with ASTM C 566 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter. The results of tests for moisture content shall be used to adjust the added water in the control of the batch plant.

d. Moisture Content Corrective Action - Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine-aggregate batcher and water batcher shall be adjusted (directly or by means of a moisture compensation device) if necessary to maintain the specified slump.

3.7.2.2 Coarse Aggregate

a. Grading - At least once during each consecutive 8 hours of operations in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control.

However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for graduation control which are coarser than the specification limits for samples taken at locations other than as delivered to the mixer to allow for degradation during handling.

b. Corrective Action for Grading - When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of five tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

c. Coarse Aggregate Moisture Content - A test for moisture content of each size group of coarse aggregate shall be made at least twice per week. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified above for fine aggregate, until the difference falls below 1.0 percent.

d. Coarse Aggregate Moisture Corrective Action - Whenever the moisture content of any size of coarse aggregate changes by 0.5 percent or more, the scale setting for the coarse aggregate batcher and the water batcher shall be adjusted if necessary to maintain the specified slump.

3.7.2.3 Quality of Aggregates

a. Frequency of Quality Tests - Thirty days prior to the start of concrete placement the Contractor shall perform all tests for aggregate quality listed below. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality in accordance with the frequency schedule shown below. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

PROPERTY	FREQUENCY FINE AGGREGATE	FREQUENCY COARSE AGGREGATE	TEST
Specific Gravity	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Absorption	Every 3 months	Every 3 months	ASTM C 127 ASTM C 128
Durability Factor Using, (Procedure A)	Every 12 months	Every 12 months	COE CRD-C 114 ASTM C 666
Alkali Reactivity	Every 3 months	Every 3 months	ASTM C 1260
Clay Lumps and Friable Particles	Every 3 months	Every 3 months	ASTM C 142

PROPERTY	FREQUENCY FINE AGGREGATE	FREQUENCY COARSE AGGREGATE	TEST
Material Finer than the 75-µm (No. 200) Sieve	Not applicable	Every 3 months	ASTM C 117
Impurities	Every 3 months	Not applicable	ASTM C 40 ASTM C 87
L.A. Abrasion	Not applicable	Every 6 months	ASTM C 131 ASTM C 535
Petrographic Examination	Every 6 months	Every 6 months	ASTM C 295
Total Chert, than less 2.40 specific gravity	Every 6 months	Every 4 hours	ASTM C 123
Coal and Lignite, less than 2.00 gravity	Every 3 months	Every 3 months	ASTM C 123

b. Corrective Action for Aggregate Quality - If the result of a quality test fails to meet the requirements for quality immediately prior to start of concrete placement, production procedures or materials shall be changed and additional tests shall be performed until the material meets the quality requirements prior to proceeding with either mixture proportioning studies or starting concrete placement. After concrete placement commences, whenever the result of a test for quality fails the requirements, the test shall be rerun immediately. If the second test fails the quality requirement, the fact shall be reported to the Contracting Officer and immediate steps taken to rectify the situation.

3.7.2.4 Scales

a. Weighing Accuracy - The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every 3 months for conformance with the applicable requirements of paragraph BATCHING EQUIPMENT. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors.

b. Batching and Recording Accuracy - Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. The Contractor shall confirm that the calibration devices described in paragraph BATCH PLANT for checking the accuracy of dispensed admixtures are operating properly.

c. Scales Corrective Action - When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected

immediately.

3.7.2.5 Batch-Plant Control

The measurement of all constituent materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

3.7.2.6 Concrete Mixture

a. Air Content Testing - Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government quality assurance representative. Tests shall be made in accordance with ASTM C 231. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single test result reaches either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the control chart for air content and the control chart for range, and for determining the need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph AIR CONTENT. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a control chart for range where an upper warning limit is set at 2.0 percentage points and up upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the air content at the mixer controlled as directed.

b. Air Content Corrective Action - Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as is practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the control chart range reaches the warning limit, the admixture dispenser

shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted. All this shall be at no extra cost to the Government.

c. Slump Testing - In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government's quality assurance representative. Test results shall be plotted on control charts which shall at all times be readily available to the Government. Copies of the current control charts shall be kept in the field by the Contractor's quality control representatives and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made on the same batch of concrete. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control chart for percent air and the chart for range, and for determining the need for any remedial action. An upper warning limit shall be set at 1/2 inch below the maximum allowable slump on separate control charts for percent air used for each type of mixture as specified in paragraph SLUMP, and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer and the slump at the mixer controlled as directed.

d. Slump Corrective Action - Whenever points on the control chart for slump reach the upper warning limit, an adjustment shall be immediately made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum W/C specified, based upon aggregates which are in a saturated surface-dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted and the Contractor shall take appropriate steps to bring the slump under control. Also, additional slump tests shall be made as directed. All this shall be at no additional cost to the Government.

e. Temperature - The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall

be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data. During hot weather conditions, mass or large placements with a least dimension of 2.5 feet shall have a temperature meassurement made for each batch or delivery at the placement location, prior to placement.

f. Compressive-Strength Specimens - At least one set of test specimens shall be made each day on each different concrete mixture placed during the day. Additional sets of test cylinders shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A random sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph DESIGN REQUIREMENTS shall consist of four cylinders, two to be tested at 7 days and two at 28 days. A set of test specimens for concrete with a 7-day strength per specified paragraph DESIGN REQUIREMENTS shall consist of six cylinders, two tested at 3 days, two at 7 days, and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. All compressive-strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength tests, moving average for strength, and moving average for range for each mixture. The charts shall be similar to those found in ACI 214.

3.7.2.7 Inspection Before Placing

Foundation or construction joints, forms, and embedded items shall be inspected for quality by the Contractor in sufficient time prior to each concrete placement to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.7.2.8 Placing

a. Placing Inspection - The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, yardage placed, and method of placement.

b. Placing Corrective Action - The placing foreman shall not permit batching and placing to begin until he has verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.7.2.9 Vibrators

a. Vibrator Testing and Use - The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency

shall be determined at the same time the vibrator is operating in concrete with the tachometer held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing.

b. Vibrator Corrective Action - Any vibrator not meeting the requirements of paragraph VIBRATORS shall be immediately removed from service and repaired or replaced.

3.7.2.10 Curing

a. Moist-Curing Inspections - At least once each shift, and once per day on nonwork days an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist-Curing Corrective Action - When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for such areas shall be extended by one (1) day.

c. Membrane-Curing Inspection - No curing compound shall be applied until the Contractor's authorized representative has verified that the compound is properly mixed and ready for spraying. At the end of each operation, he shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered and compute the rate of coverage in square feet per gallon. He shall note whether or not coverage is uniform.

d. Membrane-Curing Corrective Action - When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet-Curing Inspection - At least once each shift and once per day on nonwork days, an inspection shall be made of all areas being cured using material sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet-Curing Corrective Action - When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one (1) day.

3.7.2.11 Cold-Weather Protection and Sealed Insulation Curing

At least once each shift and once per day on nonwork days, an inspection shall be made of all areas subject to cold-weather protection. The protection system shall be inspected for holes, tears, unsealed joints, or other deficiencies that could result in damage to the concrete. Special attention shall be taken at edges, corners, and thin sections. Any deficiencies shall be noted, corrected, and reported.

3.7.2.12 Cold-Weather Protection Corrective Action

When a daily inspection report lists any holes, tears, unsealed joints, or other deficiencies, the deficiency shall be corrected immediately and the period of protection extended 1 day.

3.7.2.13 Mixer Uniformity

a. Stationary Mixers - Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the longest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers - Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

3.7.2.14 Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either the mixer shall be removed from service on the work, the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.7.3 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all test and inspection records.

LIST OF COARSE AGGREGATE SOURCES

QUARRIES	COUNTY	STATE	APPROVED LEDGE
LaFarge (Menefee) - Dresden Quarry Sec. 23, T.46N, R22W Sedalia, MO 816-826-0328	Pettis	MO	Burlington LS
Fischer Quarries Sec 17, T46, R21 Hughesville, MO 660-829-5555, 800-352-1517	Pettis	MO	Burlington LS
Hilty Quarries - Snyder QuarrY Sec. 16, T39N, R25W Clinton, MO 816-855-8135	St. Clair	MO	Burlington LS
Hilty Quarries - Tightwad Quarry Sec. 3 & 34, T41N, R24W Clinton, MO 816-855-8135	Benton	MO	Burlington LS
Hilty Quarries - Warsaw North Quarry Sec. 15, T41N, R23W Clinton, MO 816-855-8135	Benton	MO	Burlington LS
Hilty Quarries - Warsaw South Quarry Sec. 4 T39N, R22W Clinton, MO 816-855-8135	Benton	MO	Burlington LS
Ash Grove Aggregates - Wheatland QRY Sec. 2, T37N, R23W Butler, MO 816-679-4128	Hickory	MO	Burlington LS
Ag Rock Quarries SW1/4 Sec. 20, T37N, R22W Wheatland, MO	Hickory	MO	Burlington LS
Franklin Quarry Sec 34, T53N, R20W	Saline	MO	Burlington LS
Malan Quarry (Milan) Sec 5, T52N, R21W	Saline	MO	Burlington LS

LIST OF COARSE AGGREGATE SOURCES

Howard Quarry Sec 5, T52N, R21W	Saline	MO	Burlington LS

Listing of a source is not to be construed as approval of all material from the source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels when such materials are unsuitable as determined by the Contracting Officer. A winter quarrying prohibition is in effect for this Contract.

Materials may be furnished from any of the above listed sources or, at the option of the Contractor, may be furnished from any other source designated by the Contractor and approved by the Contracting Officer.

-- End of Section --

SECTION 03330

TEXTURED COLOR ADMIXTURE CONCRETE
05/01

PART 1 GENERAL

ARCHITECTURAL COLOR ADMIXTURE CONCRETE shall meet all the requirements of SECTION, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS except as modified hereinafter.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1989) Evaluation of Strength Test Results of Concrete
ACI 301	(1996) Standard Specifications for Structural Concrete
ACI 303R	(1991) Cast-in-Place Architectural Concrete Practice
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1992; Rev 1992; Errata) Building Code Requirements for Reinforced Concrete
ACI 318M/318RM	(1992) Building Code Requirements for Reinforced Concrete (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates

ASTM C 39	(1994) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(1992) Organic Impurities in Fine Aggregates for Concrete
ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beam of Concrete
ASTM C 87	(1983; R 1990) Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	(1994) Lightweight Pieces in Aggregate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1978; R 1990) Clay Lumps and Friable Particles in Aggregates
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 192	(1990a) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1994) Air-Entraining Admixtures for Concrete

ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(1994) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 441	(1989) Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 566	(1989) Total Moisture Content of Aggregate by Drying
ASTM C 595	(1994a) Blended Hydraulic Cement
ASTM C 597	(1983; R 1991) Pulse Velocity Through Concrete
ASTM C 618	(1994a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 666	(1992) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 803	(1990) Penetration Resistance of Hardened Concrete
ASTM C 805	(1994) Rebound Number of Hardened Concrete
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 979	Pigment
ASTM C 989	(1994a) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1991) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064	(1986; R 1993) Temperature of Freshly Mixed Portland Cement Concrete

ASTM C 1077	(1995a) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1991a) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM E 1155	(1987) Determining Floor Flatness and Levelness Using the F-Number System
ASTM E 1155M	(1987) Determining Floor Flatness and Levelness Using the F-Number System (Metric)

CORPS OF ENGINEERS (COE)

COE CRD-C 94	(1995) Specifications for Surface Retarders
COE CRD-C 100	(1975) Method of Sampling Concrete Aggregate and Aggregate Sources, and Selection of Material for Testing
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 114	(1994) Test Method for Soundness of Aggregates by Freezing and Thawing of Concrete Specimens
COE CRD-C 130	(1989) Estimating Scratch Hardness of Coarse Aggregate Particles
COE CRD-C 143	(1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate
COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete
COE CRD-C 318	(1972) Cloth, Burlap, Jute (or Kenaf)
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1994) NIST Handbook 44: Specifications,

Tolerances, and other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100 (1990) Concrete Plant Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only. When used, a designation following the "GA" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Concrete Mixture Proportioning, GA-GL

MIXTURE PROPORTIONING, GA-GL

Concrete mixture proportions shall be determined by the Contractor and submitted for review. The concrete mixture quantities of all ingredients per cubic yard and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate the mass of cement, pozzolan and ground granulated blast-furnace (GGBF) slag when used, and water; the mass of aggregates in a saturated surface-dry condition; and the quantities of admixtures. The submission shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No substitution shall be made in the source or type of materials used in the work without additional tests to show that the quality of the new materials and concrete are satisfactory.

Batch Plant; GA-GL,

The Contractor shall submit batch plant data to the Contracting Officer for review for conformance with applicable specifications.

Concrete Mixers; GA-GL,

Capacity; GA-GL,

The Contractor shall submit concrete mixer data which includes the make, type, and capacity of concrete mixers proposed for mixing concrete.

Conveying Equipment; GA-GL,

The conveying equipment and methods for transporting, handling,

and depositing the concrete shall be submitted for review by the Contracting Officer for conformance with paragraphs, "CAPACITY" and "CONVEYING EQUIPMENT."

Placing Equipment; GA-GL,

All placing equipment and methods shall be submitted for review by the Contracting Officer for conformance with paragraph, "CAPACITY."

Tests and Inspections; GA-GL,

Testing Technicians; GA-GL,

Concrete Transportation Construction Inspector (CTCI); GA-GL,

The Contractor shall submit statements that the concrete testing technicians and the concrete inspectors meet the specified requirements.

Construction Joint Treatment; GA-GL

The method and equipment proposed for joint cleanup and waste disposal shall be submitted for review and approval.

Curing and Protection; GA-GL

The curing medium and methods to be used shall be submitted for review and approval.

Cold-Weather Placing; GA-GL

If concrete is to be placed under cold-weather conditions, the proposed materials, methods, and protection shall be submitted for approval.

Hot-Weather Placing; GA-GL

Finishing; GA-GL

If concrete is to be placed under hot-weather conditions, the proposed materials and methods shall be submitted for review and approval.

SD-14 Samples

Aggregates; GA-GL

Cementitious Materials, Admixtures, and Curing Compound; GA-GL

Color Admixture; GA-GL

Surface Sealer; GA-GL

Form Release Agents; GA-GL

Material quality control; GA-GL
Patching material Samples; GA-GL

Samples of materials for government testing and approval shall be submitted as required in paragraph, "PRECONSTRUCTION SAMPLING AND TESTING."

SD-09 Reports

Quality of Aggregates; GA-GL

Aggregate quality tests shall be submitted at least 30 days prior to start of concrete placement.

Mixer Uniformity; GA-GL.

The results of the initial mixer uniformity tests shall be submitted at least 5 days prior to the initiation of placing.

Tests and Inspections; GA-GL

Time standards; GA-GL

The slump of the concrete; GA-GL

Moisture Test; GA-GL

Moisture Control; GA-GL

Test results and inspection reports shall be submitted daily and weekly.

SD-13 Certificates

Membrane-Forming Curing Compound; GA-GL

Fibreglass Form Ties; GA-GL

Surface Sealer; GA-GL

1.3 COLORED AND TEXTURING CONCRETE LIMITS:

The wall stem along the following designated structures shall be constructed of colored and textured concrete: Q3A, R1A, R2 and Q0. Included in the definition of "wall stem" are the following:

a. The storage monolith and closure monolith stems at the one rolling gate opening, R2.
b. The I-wall transition concrete cap and concrete floodwall wall stem on all monoliths M27, 1, 2, 3, associated with closure R2.
c. The stem at the stoplog gaps, R1A, Q3A and Q0.
d. The I-wall transition concrete caps at structures R1A, Q3A and Q0.

Note that the floodwall pile cap base at all closure/storage monoliths is not included in the scope of concrete coloration. The texturing pattern for the wall stem is located as shown on the drawings.

PART 2 PRODUCTS

2.1 MATERIALS:

2.1.1 Color Admixture.

Color admixture for concrete shall be the product of a manufacturer regularly engaged in the production of colored admixtures for concrete, and shall have a history of at least 2 years of use of the material in a similar environment without substantial fading or deleterious effects on the structural qualities of the concrete. Color admixture must be capable of evenly distributing the color throughout the concrete without segregation or causing irregular concentration of color. The pigment portion of the colored admixture shall comply with ASTM C 979.

2.1.2 Curing Materials

2.1.2.1 Membrane-Forming Curing Compound

The membrane-forming curing compound shall be clear fugitive dye and shall conform to COE CRD-C 300.

The dye shall be clearly visible on the concrete surface for at least 4 hours after application, but shall become inconspicuous within 7 days after application, when exposed to direct sunlight.

2.1.3 The color admixture

The color admixture shall produce a colored concrete which matches Munsell Color number 1OYR5/3 or (equivalent to CHROMIX admixture standard color C-11, Desert Sand).

2.1.4 Form Ties:

2.1.4.1 Fiberglass form ties

Fiberglass form ties shall be 0.500-inch diameter rod with a minimum ultimate tensile strength of 15,000 pounds. The color of the fiberglass tie shall be consistant with the color admixture for the concrete after the concrete is fully cured.

2.1.5 Surface Sealer:

Surface sealer shall be methyl methacrylate polymer acrylic emulsion, clear color.

2.1.6 Form Release Agents:

Form release agents shall be manufacturer's standard, nonstaining,

nonpetroleum based, compatible with surface sealer finish coating.

2.1.7 Material quality control

Coarse aggregate, fine aggregate, cement, admixture and curing compound used in the concrete shall be from the same source (quarry, sand pit or manufacturing plant) for the entire project. Samples of these materials used in the approved test panel shall be retained and used for material quality control.

2.1.8 Patching material Samples

Samples of materials used in patching shall also be retained and used for quality control.

2.2 MIXTURE PROPORTIONING:

The job-mix formula which gives the Concrete Mixture Proportioningshall be the responsibility of the contractor. The manufacture of the color admixture shall provide assistance to the contractor in the development of the job-mix formula using the materials specified elsewhere in these specifications.

2.3 SPECIAL REQUIREMENTS FOR PRODUCTION OF CONCRETE:

2.3.1 The batching (mixing) plant

The batching (mixing) plant shall be located on the job site at the location shown on drawings.

2.3.2 Admixture

The admixture shall be batched in a manner that will ensure that the admixture is completely and thoroughly mixed throughout the concrete. Quantities of admixture added to concrete shall be controlled to avoid variations in color between adjacent placements as well as maintain a consistent coloring throughout the project area.

2.3.3 Moisture Control.

The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates, and to change the weights of the materials being batched. An electric moisture meters complying with the provisions of COE CRD-C 143 shall be provided for measuring of moisture of aggregates. The sensing elements shall be arranged so the measurement is made near the charging gate of the aggregate bins or in the batcher. Coarse and fine shall be stockpiled at the batch plant for at least two days prior to use.

2.3.3.1 Moisture Test:

Coarse and fine aggregates shall be tested in accordance with ASTM C 127 and ASTM C 128 before each concrete placement. During placement coarse aggregate shall be tested every 4 hours and fine aggregate shall be tested

each hour).

2.3.3.2 The slump of the concrete

The slump of the concrete shall be consistent throughout the project at 4 inches or less. The slump shall be checked for each truck load at the forms.

2.3.3.3 Water

All the water shall be added to the mix by the mixing plant.

2.3.4 Time standards

The time between mixing and placement in the forms shall be consistent throughout the project.

2.3.5 Mixers

Mixers shall be cleaned thoroughly before concrete production. Recommended final cleaning procedure is to add about 50 gallons of water and a portion of coarse aggregate to the mixer and mix until the mixer is clean.

2.3.6 Priming Slurry

When colored concrete is to be pumped, the priming slurry for the hose must be colored with the Colored Admixture.

2.4 MIXING CONCRETE:

2.4.1 Recommended Mixing Procedure

The quantity of concrete being mixed in a mixer shall be no less than 40% of the capacity of the mixing drum and must always be in full yard increments. Recommended mixing procedure is as follows:

a. At least 50% of the water
b. Color Additive (thoroughly mixed)
c. Coarse Aggregate
d. Cement
e. Fine Aggregate
f. Remainder of the water
g. Mix a minimum of 3-4 minutes

2.4.2 Clean any color

In order to clean any color admixture off of the backside of the mixing fins the mixer shall be stopped during the later part of the mixing cycle and the direction of rotation reversed until the concrete is just ready to pour out of the mixer. Then complete the mixing cycle.

2.5 SPECIAL FORMING AND TEXTURING:

2.5.1 Formwork for architectural

Formwork for architectural concrete shall be of the highest quality to obtain smooth, straight, non-yielding surfaces. Form system may be nonintrusive so as not to require any internal tie system or may use an internal tie system. Deflection shall not exceed 1/360th of each component span or distance between adjacent supports. Deflections and tolerance shall not be cumulative. Form lumber shall be of a resin overlay type or have a polyurethane or similar coating sufficiently heavy to prevent transfer of wood grain and to fill and cover boats (plugs) in plywood. All wood form joints shall be cleaned of release agent residue and then sealed with a 2" wide vinyl or polyester film tape to prevent leakage of mix water. A silicone sealant may be used for joint sealing. Form Liners shall be watertight. Holes in forms for snap ties shall not be larger than 5/8 inches for fiberglass ties. Formwork shall conform to ACI 301.

2.5.2 Color and Appearance

Any leakage varies the water/cement ratio of the cement paste and hence the color and appearance adjacent to that area. Sandblasting or bushhammering will not remove these irregularities. Form release agents used shall be nonstaining. All vertical surfaces shall be cast to their full height between engineered horizontal joints. If possible, both external and internal vibrators should be used. Over-vibration shall be avoided. The heads of internal vibrators shall never touch the forms.

2.5.3 Surface Requirements:

The surface requirements for the classes of finish required by Section, FORMWORK FOR CONCRETE, shall be as hereinafter specified. Allowable irregularities are designated "abrupt" or "gradual" for purposes of providing for surface variations. Offsets resulting from displaced, misplaced or mismatched forms, or sheathing, or by loose knots in sheathing, or other similar form defects, shall be considered "abrupt" irregularities. Irregularities resulting from warping, unplaneness or similar uniform variations from planeness, or true curvature, shall be considered 11gradual" irregularities. "Gradual" irregularities shall be checked for compliance with the prescribed limits with a 5-foot template, consisting of a straightedge for plane surfaces and a shaped template for curved or warped surfaces. In measuring irregularities, the straight edge or template may be placed anywhere on the surface in any direction, with the testing edge held parallel to the intended surface.

	Irregularities	
	Abrupt, inches	Gradual, inches
Irregularities limits	1/8	1/4

2.5.4 TEXTURING

The finished wall surfaces shall match the arched and edge details of the fractured fin finish pattern, as shown on the drawings.

2.6 PATCHING:

The manufacturer of the color-conditioning admixture shall provide a

factory-formulated colored patching material that matches the surface being patched to the satisfaction of the Contracting Officer (SD14GA). The substrate should be thoroughly moistened before patching. An Acrylic concrete bonder should be applied to the substrate and added to the patching mix. Prior to the performance of any job patching, the Contractor shall test patch the original sample panel and obtain color and texture approval from the Contracting Officer for that patching procedure (SD14-GA). Snap tie holes shall not be patched. The quantity of patched areas shall be strictly limited. The combined total of patched areas shall not exceed 2 sq. ft. in each 1000 sq. ft. of the surface.

2.7 TEST PANEL:

2.7.1 Construct

The Contractor shall construct a test panel for the colored concrete specified with minimum dimensions of 4 feet by 8 feet by 6 inches thick. Panels shall be constructed with the 8-foot dimension in the vertical position. The panel shall incorporate the specified fractured fin formliner, and shall adequately show the arched and edge details of the fractured fin pattern as shown on the drawings. The panel shall be tinted using a pigmented admixture. The color of the panel shall be as follows:

The panel shall be tinted to the color designated as Munsell Color number 10YR5/3 (equivalent to CHROMIX admixture standard color A-312.08, C-11, Desert Sand) with the upper 4 feet lightly sandblasted.

2.7.2 Test panel

The test panel shall be placed at a location designated by the Contracting Officer. The test panel shall be constructed and cured using the materials proposed for the project. Test panel shall not be protected from the effects of the sun while curing. No concrete shall be scheduled for placement within 30 days of construction of the test panel. The test panel will be used by the Contracting Officer to approve compliance with the specification requirements for color, form material, form liner, appearance of any internal form tie system, form release agent, and final concrete mix design. When, in the opinion of the Contracting Officer, the test panel does not conform to the requirements herein, the Contractor shall construct an additional test panel at no additional cost to the Government until a final mix design has been developed that produces concrete conforming to the color requirement herein.

2.7.3 Approved test panel

The approved test panel shall be placed on the job site near the wall construction. It shall be used for texturing and coloring quality control until the project is completed. Upon completion of the project the test panels will become the property of the Contractor.

PART 3 EXECUTION

3.1 SURFACE CLEANING:

Surfaces shall be lightly sandblasted to remove minor form marks and colored residue resulting from water, cement, and coloring agents migrating (bleeding) toward the forms during concrete placement as directed by the Contracting Officer.

3.2 SURFACE SEALING:

After cleaning, exterior exposed architectural concrete surfaces indicated shall be given one coat of surface sealer, spray applied unless otherwise approved. Adjacent surfaces shall be protected to prevent damage from the surface sealer. Rate of application shall be as recommended by the manufacturer.

3.3 EVALUATION AND ACCEPTANCE:

Colors of pigmented concrete shall be considered satisfactory based on the comparative analysis of color produced from test panel(s) in accordance with paragraph, "TEST PANEL, AND MUNSELL COLOR" samples in accordance with U.S. Department of Agriculture Handbook 18 - Soil Survey Manual. Color of concrete shall conform to Munsell Color number selected by the Contracting Officer in accordance with subparagraph, "Test Panel, with respect to hue, value and chroma."

-- End of Section --

SECTION 03416

PRECAST CONCRETE
07/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	(1977; R 1989) Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 150	(1997) Portland Cement
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 311	(1997) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 430	(1994) Standard Test Method for Fineness

	of Hydraulic Cement by the 45-Micrometer (No. 325) Sieve
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595	(1994a) Blended Hydraulic Cements
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 1069	(1986; R 1992) Specific Surface Area of Alumia or Quartz by Nitrogen Adsorption

PRECAST PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI Mnl-116s	(1985) Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI Mnl-120	(1999) PCI Design Handbook - Precast and Prestressed Concrete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-04 Drawings

Erection; G-AE

The Contractor shall prepare and submit for approval complete shop drawings that show the precast unit manufacturer's recommended details and materials for the work required by paragraphs, "DELIVERY, STORAGE, AND HANDLING" and "ERECTION." The shop drawings shall include: design computations; marking of the units for the placing drawings; anchorages for work of other trades; anchorages to support construction; location and sizes of all openings 12 in. wide or larger to be cast into members; formwork; joints between units and other construction; reinforcing steel details; method of curing; and, pickup points and lifting devices.

SD-01 Data

Erection Plan; G-RE.

The Contractor shall prepare a detailed erection plan which shall be submitted at least 15 days prior to the date that erection of members is to begin.

Design Calculations; G-AE.

Design calculations shall be submitted prior to the initiation of manufacture of members to be used under this contract.

Complete design analysis and load charts stamped and signed by a professional engineer and in booklet form for the units to be furnished. Analysis shall include mixture proportion, concrete strenght, stress calculations, code the design is based on, and shall include the lifting stresses and lifting inserts.

Concrete Mixture Proportions; G-RE.

Concrete mixture proportions shall be submitted for approval.

Construction Records; RE.

Construction records of the manufacturing, handling, and erection of the precast concrete members shall be submitted.

SD-09 Reports

Materials; RE.

Certified test reports of required material tests shall be submitted prior to the use of the materials in the work. Reports shall be furnished for each shipment and shall be identified with specific lots.

Concrete; RE .

The results of concrete strength testing by the contractor shall be submitted not more than 5 days after the tests are completed.

SD-13 Certificates

Cement; RE,
Pozzolan; RE,
Air-Entraining Admixture; RE,
Water-Reducing Admixture; RE,
Accelerating Admixture; RE,
Aggregates; RE,

Cement, Pozzolan, Air-Entraining Admixture, Water-Reducing Admixture, Accelerating Admixture, shall be certified for compliance with all specifications requirements.

Air Content; RE

Each precast member delivered to the jobsite shall be accompanied by a certificate certifying that the air content in the concrete in that member is in compliance with the specifications. The certification must be based on an air content

test conducted in conformance with ASTM C 231 on at least one of the batches of concrete from which the member was cast.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

1.3.1.1 Precast Members and Connections

Design of members and connections shall be in accordance with ACI 318/318R and PCI Mnl-120. Provide minimum reinforcing steel as noted on the drawings. Add additional reiforcing steel as may be required for all construction loads including handling and erection loads.

1.3.1.2 Loads

Loadings for members and connections shall include all dead load, live load, applicable lateral loads such as wind and earthquake, applicable construction loads such as handling, erection loads, and other applicable loads as shown on the drawings.

1.3.1.3 Design Calculations

Design calculations for members and connections not shown in the contract drawings shall be made by a registered professional engineer experienced in the design of precast concrete.

1.3.2 Performance Requirements

Perform the following testing to ensure the materials and method used meet the requirements of these specifications and will produce precast concrete members which are suitable for their intended use.

1.3.2.1 Concrete

Concrete shall be sampled and cylinders made in accordance with ASTM C 172 and ASTM C 31/C 31M.

a. Concrete Test Cylinders. A minimum of two concrete test cylinders per bed shall be made to verify the strength of concrete at the time of stress transfer and a minimum of two test cylinders per day or 50 cubic yards of concrete or fraction thereof, whichever results in the most cylinders, shall be made for each mix design to verify the attainment of the specified strength.

b. Cylinder Making. Cylinders shall be made as near as possible to the location where they will be cured and shall not be disturbed in any way from 1/2 hour after casting until they are either 24 hours old or ready to be tested. Concrete in cylinders may be consolidated by rodding or by vibration as specified in ASTM C 31/C 31M.

c. Cylinder Curing

(1) Test cylinders shall be cured with similar methods as the

members they represent. In lieu of actual curing with the members, cylinders may be cured in curing chambers correlated in temperature and humidity with the beds. In such a case, the correlation shall be constantly verified by use of recording thermometers in the curing chambers and comparison with the temperature records of beds and by use of the same methods of moisture retention for curing chambers and casting beds.

(2) For beds cured by steam or radiant heat, cylinders shall be placed at random points along the bed. If there is any indication of variable heat, cylinders shall be placed in the coolest area.

(3) Test cylinders to indicate compliance with specified 28-day or earlier strength shall remain in the bed with the member until the member is removed. At that time, the cylinders shall be removed from their molds and placed in storage in a moist condition at 73.4 degrees plus or minus 3 degrees F.

d. Testing of Cylinders

(1) Testing of cylinders to determine compressive strength shall be performed in accordance with ASTM C 39. The strength of concrete at any given age shall be determined as the average of two cylinders, except a single cylinder test can be used to determine stress transfer strength or predictive strengths at less than 28 days.

(2) Testing machines shall be calibrated in accordance with ASTM C 39.

1.3.2.2 Air Content

The air content tests shall be conducted in accordance with ASTM C 231. At least one air content test shall be conducted on the concrete from which each member is cast.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Transportation

1.4.1.1 Transporting Members

In transporting members by truck, railroad car, or barge, provision shall be made for supporting the members as described above, except battens can be continuous over more than one stack of units, with adequate bracing to ensure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are satisfactory provided the members are fully seated on the outer bolsters at not more than 3 feet or the depth of the member from the end and the inner bolster is not more than 8 feet from the end of the member or the designated pickup point. Adequate padding material shall be provided between tie chains or cables to preclude chipping of concrete.

1.4.1.2 Lateral Deflection or Vibration

Any noticeable indication of lateral deflection or vibration during transportation shall be corrected by rigid bracing between members or by means of lateral trussing.

1.4.2 Storage

1.4.2.1 Storage Areas

Storage areas for members shall be stabilized, and suitable foundations shall be provided, so differential settlement or twisting of members will not occur.

1.4.2.2 Stacked members

Stacked members shall be separated and supported by battens placed across the full width of each bearing point. Battens shall be arranged in vertical planes at a distance not greater than the depth of the member from designated pickup points. Battens shall not be continuous over more than one stack of precast units. Stacking of members shall be such that lifting devices will be accessible and undamaged. The upper members of a stacked tier shall not be used as storage areas for shorter members or equipment.

1.4.3 Handling of Members

The location of pickup points for handling of the members and details of the pickup devices shall be shown in shop drawings. Members shall be handled only by means of approved devices at designated locations. Members shall be maintained in an upright position at all times and picked up and supported as shown in approved shop drawings.

1.5 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall comply with the following:

2.1.1 Cement

Cement shall comply with the following:

2.1.1.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type I, II or III.

2.1.1.2 Blended Hydraulic Cement

Blended hydraulic cement shall conform to ASTM C 595 Type IS , Type IP , Type I(SM) .

2.1.1.3 Silica Fume

Silica fume may be furnished as a dry, densified material or as a slurry. Silica fume, unprocessed, or before processing into a slurry or a densified material, shall conform to the following requirements:

a. Silicon dioxide content: 85-percent minimum, test method ASTM C 311.

b. Loss on ignition: 6.0-percent maximum, test method ASTM C 311.

c. Surface area, nitrogen adsorption, 15,000 m_2/kg minimum, test method ASTM C 1069.

d. Oversize, percent retained on 45-micrometer sieve: 5-percent maximum, test method ASTM C 430.

The Contractor shall provide at his expense the services of a manufacturer's technical representative, experienced in mixture proportioning, placement procedures, and curing of concrete containing silica fume. The manufacturer's representative shall be available for consultation by both the Contractor and the Government during mixture proportioning, planning, and production of silica-fume concrete and shall be on site immediately prior to and during at least the first placement of concrete containing silica fume and at other times, if directed.

2.1.2 Pozzolan

Pozzolan shall conform to ASTM C 618 Class F or C.

2.1.3 Other Materials

2.1.3.1 Aggregates

Aggregates shall meet the requirements of ASTM C 33 .

2.1.3.2 Admixtures

In no event shall admixtures containing chlorides or nitrates be used in the concrete.

a. Air-entraining admixture shall be certified to comply with ASTM C 260.

b. Water-reducing admixture shall be certified to comply with ASTM C 494 Type A.

c. Accelerating admixture shall be certified to comply with ASTM C 494 Type C.

2.1.4 Steel Reinforcement

Steel reinforcement shall be in accordance with Section, CONCRETE REINFORCEMENT.

2.2 CONCRETE MIXTURE PROPORTIONS

2.2.1 Concrete

Concrete shall be composed of cementitious material, water, fine and coarse aggregate, and admixtures. The cementitious material shall be portland or blended hydraulic cement and pozzolan where appropriate. The admixtures shall be an air-entraining agent and may include a water-reducing admixture when its formulation and use are approved.

2.2.2 Proportions

The concrete mixture proportions shall meet the following requirements:

Specified Strength = 5000 psi at 28 days.

Air Content = 5 to 7 percent as determined in accordance with ASTM C 231. Proportions shall be selected so as to produce an average strength exceeding the design strength f'c by the amount indicated below. Where the production facility has a standard deviation record determined in accordance with ACI 214, based on 30 consecutive strength tests of similar mixture proportions to that proposed, obtained within 1 year of the time when concrete placing is expected, it shall be used in selecting average strength. The average strength used as the basis for selecting proportions shall exceed the specified strength f'c by at least.

400 psi if standard deviation is less than 300 psi
550 psi if standard deviation is 300 to 400 psi
700 psi if standard deviation is 400 to 500 psi
900 psi if standard deviation is 500 to 600 psi

If the standard deviation exceeds 600 psi or if a standard deviation record is not available, proportions shall be selected to produce an average strength at least 1,200 psi greater than the specified strength.

Mixtures shall be proportioned in accordance with ACI 211.1. The trial mixtures shall be formulated using the same materials as those to be used in the units supplied under this specification, and the selected proportions shall be submitted for approval with the results of cylinder strengths at 28 days.

2.3 EVALUATION AND ACCEPTANCE

2.3.1 Concrete

A test result shall be the average of the strengths of the two test cylinders made in accordance with paragraph, "SYSTEM DESCRIPTION," subparagraph "PERFORMANCE REQUIREMENTS," subparagraph "CONCRETE,"

subparagraph "CONCRETE TEST CYLINDERS." The strength level of the concrete will be considered satisfactory if the average of all sets of three consecutive strength tests equal or exceed the specified strength f'(c) and no individual test falls below the specified value by more than 500 psi. Members manufactured with concrete that does not meet the strength requirements shall be rejected.

2.3.1.1 Air Content

All members cast with concrete having a measured air content less than 5 percent shall be rejected. Members cast with concrete having an air content up to 9 percent may be incorporated into the work if the strength requirements are met.

2.3.2 Tolerances

The precast-prestressed members shall be manufactured within the following tolerances. Members failing to meet the dimensional tolerances shall be rejected.

2.3.2.1 Length of Member

The length of the member shall not deviate from the length shown in the contract drawings by more than plus or minus 3/4 inch or plus or minus1/8 inch per 10 feet of length, whichever is greater.

2.3.2.2 Cross-sectional Dimensions

The cross-sectional dimensions of a member, if less than 36 inches, shall not vary by more than plus or minus 1/4 inch and, if over 36 inches, they shall not vary by more than plus or minus 3/8 inch.

2.3.2.3 Handling Devices

The actual position of handling devices shall not deviate from the designed position by more than plus or minus 6 inches.

2.3.2.4 Anchors and Inserts

The actual position of anchors and inserts shall not vary by more than plus or minus 1 inch from positions shown in the contract drawings.

2.3.2.5 Slab Thickness

The thickness of a flange or slab shall not vary from the dimensions in the drawings by more than plus 1/4 inch or minus 1/8 inch.

2.3.2.6 Squareness of Ends

The ends of members shall not deviate from being square by more than plus or minus 1/4 inch. Squareness shall be checked in both the vertical and horizontal planes.

2.3.3 Defects

2.3.3.1 Minor Defects

Minor defects are those which involve less than (36 square inches) of concrete and do not expose reinforcing steel. These defects will be repaired as specified hereinafter. Cracks which are visible but are (0.01 inch) wide or less will be accepted.

2.3.3.2 Major Defects

Major defects are those which involve more than 36 square inches of concrete or expose reinforcing steel. If one or more major defects appear in a member, it shall be rejected. Cracks of a width of more than (0.01 inch) shall be cause for rejection of the member.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication of precast members shall follow the applicable provisions of the PCI Mnl-116s, except as specified herein.

3.2 BEDS AND FORMS

3.2.1 Casting Beds

All casting beds shall have concrete support on unyielding foundations.

3.2.2 Forms

Forms, both fixed and movable, shall be of steel. All forms and beds shall be thoroughly cleaned after each use.

3.2.3 Bulkheads

Bulkheads, spacers, templates, and similar equipment having influence on the accuracy of dimensions and alignment shall be regularly inspected and maintained after each casting.

3.2.4 Alignment

Accurate alignment of forms shall be maintained during the casting operation to assure compliances with tolerances specified in paragraph, "EVALUATION AND ACCEPTANCE." Leakage of the paste in form joints is not acceptable, and measures shall be taken to prevent such leakage. Measures shall also be taken to provide corner chamfers.

3.2.5 Form Ties

For exposed members, form ties, if used, shall be of the threaded or snap-off type so no parts will be left at the surface of the finished concrete.

3.3 STEEL REINFORCEMENT

Steel bars and welded wire fabric shall be placed in accordance with Section, CONCRETE REINFORCEMENT.

3.4 CONCRETE PLACEMENT

Concrete placement shall be in accordance with Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS, except that once placement is started in a member it shall be carried on in a continuous operation until the member is completed. Members shall be cast in a horizontal position and casting in tiers will not be permitted. Adequate vibration shall be provided with internal and form vibrators so the cast members shall be free of rock pockets or surface blemishes resulting from inadequate vibration. Cold joints shall not be permitted in prestressed concrete members. If delays occur that result in hardening of the concrete so it will not receive a vibrator and again become plastic, the concrete shall be removed and the forms shall be washed out and refilled, otherwise partially cast members will be rejected.

3.5 CURING AND PROTECTION

Concrete for the manufacturing of the precast-prestressed concrete members shall be cured and protected in accordance with Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS or by other methods further specified here.

3.5.1 Curing with Steam at Atmospheric Pressure

Steam curing shall be under a suitable enclosure to retain the live steam to minimize moisture and heat losses. The enclosure shall allow free circulation of the steam around the sides and top of the beams. Steam jets shall be so positioned so they do not discharge directly on the concrete, forms, or test cylinders. The cycle of steam application shall conform to the following:

3.5.1.1 Curing After Placing and Vibrating

After placing and vibrating, the concrete shall be allowed to attain its initial set before the steam is applied. During the period between placement of the concrete and application of steam, provisions shall be made to prevent surface drying by means of a coating of membrane curing compound, moist covers, or equally effective methods. Application of the steam shall be delayed not less than 2 hours and not more than 10 hours after the time of concrete placement. If the ambient temperature is below 50 degrees F, enough heat shall be applied to maintain the concrete at its placing temperature.

3.5.1.2 Temperature Increase

The ambient temperature within the casting enclosure shall be increased at a rate not to exceed 40 degrees F per hour. Temperature increase shall be as uniform as possible.

3.5.1.3 Temperature Range

The temperature shall be increased until the ambient temperature in the casting enclosure is between 140 and 160 degrees F. Once this temperature range is reached, it shall be maintained until the concrete has reached the compressive strength necessary.

3.5.1.4 Temperature Decrease

In discontinuing the steam curing, the ambient air temperature shall decrease at a rate not to exceed 40 degrees F per hour. Temperature decrease shall be as uniform as possible.

3.5.1.5 Recording Thermometers

Recording thermometers showing the time-temperature relationship through the curing period shall be provided. At least one recording thermometer per casting enclosure shall be used. The desired curing time-temperature relationship shall be placed on the recording chart of the recording thermometer to aid the personnel controlling the temperature during curing. Recording charts shall be made available upon request and shall be clearly visible during the curing process.

3.5.2 Curing with Radiant Heat and Moisture

3.5.2.1 Radiant Heat

Radiant heat may be applied to beds by means of pipe circulating steam, hot oil, or hot water or by electric blankets or heating elements on forms. Pipes, blankets, or elements shall not be in contact with concrete, form surface, or test cylinders.

3.5.2.2 Moisture Loss

During the cycle of radiant heat curing, effective means shall be provided to prevent rapid loss of moisture in any part of the member. Moisture may be applied by a covering of moist burlap or cotton matting. Moisture may be retained by covering the member with a plastic sheet in combination with an insulating cover or by applying a liquid seal coat or membrane curing compound.

3.5.2.3 Temperature Limits

Temperature limits and use of recording thermometer shall be as specified for curing with steam at atmospheric pressure.

3.5.2.4 Termination of Curing

Termination of curing shall be as specified in Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS unless the concrete has been cured by one of the two methods stated above. Termination of curing for concrete cured by either the steam at atmospheric pressure method or the radiant heat with moisture shall be determined based on the compressive strength of the concrete necessary.

3.6 REPAIRS

All honeycombed areas, chipped corners, air pockets over 1/4 inch in diameter, and other minor defects shall be repaired. Form offsets of fins over 1/8 inch shall be ground smooth. All unsound concrete shall be removed from defective areas prior to repairing. All surfaces permanently exposed to view shall be repaired by a blend of portland cement and white cement properly proportioned so that the final color when cured will be the same as adjacent concrete.

3.7 FINISHING

3.7.1 Unformed surfaces

Unformed surfaces shall receive a wood float finish.

3.8 ERECTION

Erection shall comply with the following.

3.8.1 Storage Provisions

All provisions for storage and handling given in paragraph, "DELIVERY, STORAGE, AND HANDLING" shall be observed at the erection site.

3.8.2 Seating of Precast Concrete Members

The precast concrete members shall be set into place in a manner which assures full bearing. If the bearing called for in the contract drawing is not obtained, then the members shall be removed and the situation corrected.

3.8.3 Welding

Welding during erection shall be done in accordance with Section, METALWORK FABRICATION, MACHINE WORK AND MISCELLANEOUS PROVISIONS. When welding or burning with a welding electrode, the ground shall be attached directly to the base metal. Under no circumstances shall the member be used as a conductor for the ground.

3.8.4 Erection Plan

The erection plan shall be in sufficient detail so that adequacy of equipment, techniques, and accessories can be determined and comments offered. Acceptance of the Contractor's erection plan shall not relieve the Contractor of his responsibility for erecting precast members into position as required by the plans and specifications.

3.9 CONSTRUCTION RECORDS

Complete construction records shall be kept of the manufacturing, handling, and erection of the precast concrete members. Records shall be kept for, but not limited to, the following items:

a. Specifications of material used in the manufacture of the members.

b. Records of the inspection of the members each time they are moved.

c. Records of any defects in the member and any corrective measures taken.

-- End of Section --

PHASE II

DIVISION 4 – MASONRY

NOT APPLICABLE

PHASE II

DIVISION 5 – METALS

05055	Metalwork Fabrication, Machine Work, Miscellaneous Provisions
05120	Structural Steel
05900	Flap Gates Miscellaneous Drainage Structures
05901	Trash Racks

SECTION 05055

METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS
12/92

PART 1 GENERAL

1.1 SCOPE

The work required by this section consists of the general workmanship and standards which are applicable to the fabrication, assembly and erection of the various items of metalwork covered by this contract work to ensure conformity with the specifications and miscellaneous requirements incidental to the work. These requirements are additional to those contained in the section pertaining to a specific item of work or to a requirement indicated on the contract drawings.

Also the work covered by this section consists of providing all plant, equipment, materials and labor for fabricating, furnishing, erecting, and installing all metalwork, standard articles, and shop-fabricated items. Miscellaneous metalwork, standard articles and shop-fabricated items include all materials not covered elsewhere in these Specifications for payment items, but are indicated or shown on the contract drawings which are incidental or listed herein, along with all sundry items not specifically mentioned, including handrails; grab bars; ladder rungs; landing platforms; ladders; gratings; grate covers; safety chains; padlocks; cable; shackles and turnbuckles; plates, angles, wide flange posts, lifting beam; drain pipe and miscellaneous items for stoplog gap and stoplog storage; angle posts; embedded plates and angles for miscellaneous items such as blockouts, sills, recesses, pedestals and tie-downs; rubber J-seals; neoprene strip, eyebolts; and studs.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1.2.1 Structural Metals

Fabrication requirements and workmanship provisions for items specified in this section shall conform with the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS and Structural Steel.

Structural Steel shall be in accordance with Structure Steel specification Section

1.2.2 Painting

Section, PAINTING: HYDRAULIC STRUCTURES.

1.2.3 Concrete

Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION

ADM	Aluminum Design Manual

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 2005-B	(1988) Design Manual for Bevel Gears
AGMA 6001-C	(1988) Design and Selection of Components for Enclosed Gear Drives

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1981) Square and Hex Bolts and Screws, Including Hex Cap Screws, and Lag Screws
ANSI B18.2.2	(1989) Square and Hex Nuts
ANSI B18.2.3	(1989) Socket Cap, Shoulder and Set Screws
ANSI B18.6.2	(R1983) Square Head Set Screws, and Slotted Headless Set Screws
ANSI B18.6.3	(R1983) Slotted and Recessed Head Machine Screws and Machine Screw Nuts
ANSI B18.21.1	(R1983) Lock Washers
ANSI B18.22.1	(R1983) Plain Washers
ANSI/NAAMM MBG 531	Gratings, Metal, Bar Type (Floor, Except for Naval Vessels

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)Org

ASME B46.1	(1955) Surface Texture (Surface Roughness, Waviness and Lay

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A1	(1984) Carbon Steel Tee Rails
ASTM A27	(1991) Steel Castings, Carbon, for General Application
ASTM A36	(1991) Structural Steel
ASTM A53	(1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless Ref Title
ASTM A108	(1990a) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 123	(1989a) Zinc (Hot-Galvanized) Coatings on Iron and Steel Products
ASTM A153	(R1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A167	(1991) Stainless and Heat-Resisting Chromium-Nickel Stell Plate, Sheet and Strip
ASTM A193	(1991a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A194	(1991) Carbon and Alloy-Steel Nuts for Bolts for High-Temperature Service
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A307	(1991) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	(1991c) Structural Bolts, Steel, Heat-Treated, 12/1-5 ksi Minimum Tensile Strength
ASTM A 380	(1994a) Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A570	(1991) Steel Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A603	(1988) Zinc-Coated Steel Structural Wire Rope
ASTM A668/A668M	(1996) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 780	(1990) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B6	(1987) Zinc (Slab Zinc)
ASTM B 177	(1993) Chromium Electroplating on Steel for Engineering Use
ASTM B209	(1992a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B211	(1992a) Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B241	(1992a) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B255	(1983a) Sintered Bronze Structural Parts

ASTM B308	(1992a) Aluminum-Alloy 6061-T6 Standard Structural Shapes
ASTM B 766	(1986; R 1993) Electrodeposited Coatings of Cadmium
ASTM D 962	(1981; R 1994) Aluminum Powder and Paste Pigments for Paints
ASTM E 94	(1993) Radiographic Testing
ASTM E 165	(1995) Liquid Penetrant Examination Inspection Method
ASTM E 446	(1993) Radiographs for Steel Casting up to 2 in. (51 mm) in Thickness
ASTM E 709	(1995) Magnetic Particle Examination

ASME INTERNATIONAL (ASME)

ASME B4.1	(1967; R 1994) Preferred Limits and Fits for Cylindrical Parts
ASME B46.1	(1985) Surface Texture (Surface Roughness, Waviness, and Lay)
ASME BPV IX	(1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel
AWS D1.2	(1990) Structural Welding Code - Aluminum
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3110	(1992; Rev G) Primer Zinc Chromate
SAE AMS 3132	(1994; Rev F) Varnish, Phenolic Resin Corrosion-Preventive

FEDERAL SPECIFICATION (FED. SPEC.)

FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
QQ-B-637	Brass, Naval: Rod, Wire, Shapes, Forgings, and Flat Products with Finished Edges (Bar, Flat Wire and Strip)
QQ-L-201	Lead Sheet

RR-C-271	Chains and Attachments, Welded and Weldless

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1992	Standard Specifications for Highway Bridges
1978	Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1922	(Rev A) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 1) Shield, Expansion (Shelf Drilling Tubular Expansion Shell Bolt Anchors)
CID A-A-1925	(Rev A; Notice 1) Shield, Expansion (Nail Anchors)
CID A-A-55614	(Rev A) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Rev A) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)
CID A-A-60005	(Rev E; Notice 1) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.4 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Lists of Materials; GA-RE.

The Contractor shall furnish three copies of all purchase and mill orders, shop orders and work orders. The Contractor shall furnish a list designating the material to be used for each item at the time of submittal of shop drawings. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. The

Contractor shall also furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each piece, the number of pieces, the total weight and the car initial and number.

SD-04 Drawings

Detail Drawings; GA-RE.

Detail drawings for metalwork and machine work shall be submitted and approved prior to fabrication.

Shop Drawings; GA-RE.

Drawings shall include catalog cuts, templates, fabrication, erection and assembly details, and type, grade and class of materials as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the shop drawings.

Recess Frames; GA-RE.

Anchorage drawings.

SD-07 Schedules

Materials Orders; FIO-RE.

Copies of purchase orders, mill orders, shop orders and work orders for materials shall be submitted prior to the use of the materials in the work.

Materials List; FIO-RE.

Materials list for fabricated items shall be submitted at the time of submittal of detail drawings.

Shipping Bill; FIO-RE.

Shipping bill shall be submitted with the delivery of finished pieces to the site.

SD-08 Statements

Welding Procedures for Structural Steel; GA-RE.

Schedules of welding procedures for steel structures shall be submitted and approved prior to commencing fabrication.

Welding of Aluminum; GA-RE.

Schedules of welding processes for aluminum fabrications shall be submitted and approved prior to commencing fabrication.

Structural Steel Welding Repairs; GA-RE.

Welding repair plans for steel shall be submitted and approved prior to making repairs.

Manufacturer Design Calculations; FIO-RE.

For railings and landing platforms, manufacturer design calculations, showing that the installed railings and the landing platform are capable of withstanding loads specified, shall be submitted and approved prior to installation

SD-09 Reports

Tests, Inspections, and Verifications; FIO-RE.

Certified test reports for materials shall be submitted with all materials delivered to the site.

Test Reports for Fracture Critical Members (FCM); GA-RE.

Bound report shall contain test results on all fracture critical members and shall include record of personnel qualifications, equipment, procedures, and analysis of results along with all the test records. Report shall cover the Charpy V-notch tests, all welding tests, and chemical and mechanical properties fo the steel.

SD-13 Certificates

Qualification of Welders and Welding Operators; FIO-RE.

Certifications for welders and welding operators shall be submitted prior to commencing fabrication.

Application Qualification for Steel Studs; GA-RE.

Certified reports for the application qualification for steel studs shall be submitted and approved prior to commencing fabrication.

Welding of Aluminum; GA-RE.

Certified report for aluminum welding qualification tests shall be submitted and approved prior to commencing welding.

Certification; GA-RE.

Certification of material tests and analyses, examinations, welding procedures and welding operator qualifications shall be submitted in triplicate for approval. Test reports for material tests and analyses shall be identified with specific lots and items prior to installation.

SD-18 Records

Materials Disposition Records; FIO-RE.

Materials disposition records shall be submitted before completion of contract.

1.5 QUALITY CONTROL

1.5.1 General

The Contractor shall establish and maintain quality control for the work specified in this section to assure compliance with the contract requirements and shall maintain detailed records of his quality control for construction operations, including, but not limited to the following:

(a)Material;
(b)Fabrication and workmanship;
(c)Welding; and
(d)Installation.

1.5.2 Certification

The Contractor shall certify that all materials, either specifically manufactured for this work or manufactured as a stock item, conform to the requirements of these Specifications. Such certification will not relieve the Contractor of responsibility for any fault in operation, workmanship, or material that may develop before the completion of his work or guarantee. Tests shall be made as indicated in the respective section of the Specifications or on the contract drawings and in the presence of the Contracting Officer's Representative (COR). The Contractor shall furnish the COR certified results in triplicate of any required tests or analyses.

1.5.3 Workmanship

1.5.3.1 General

Workmanship shall be of the highest grade in accordance with the best modern practices to conform to the specifications for the item of work being furnished.

1.5.3.2 Commercial Equipment

Commercial equipment furnished under this contract, but not designed especially for this particular project, shall be the standard product of a manufacturer regularly engaged in the manufacture of equipment of this type, of current manufacture, new and unused, built on the multiple or repetitive system, suitable for the intended use. The provisions of this section shall not apply to the manufacture of the items themselves, except as specifically directed by the COR.

1.5.4 Reporting

Three copies of these records and tests, as well as records of corrective action taken, shall be furnished to the COR daily when work under this Section is being performed.

1.6 METALWORK AND MACHINE WORK DETAIL DRAWINGS

Detail drawings for metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the detail drawings.

1.7 QUALIFICATION OF WELDERS AND WELDING OPERATORS

The Contractor shall certify that the qualification of welders and welding operators and tack welders who will perform welding have been qualified for the particular type of work to be done in accordance with the requirements of AWS prior to commencing fabrication. The certificate shall list the qualified welders by name and shall specify the code and procedures under which qualified and the date of qualification. Prior qualification will be accepted if welders have performed satisfactory work under the code for

which qualified within the preceding three months. The Contractor shall require welders to repeat the qualifying tests when their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests will be recertified. Those not passing will be disqualified until passing. All expenses in connection with qualification and requalification shall be borne by the Contractor.

1.8 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 MATERIALS FOR METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS

2.1.1 Materials Orders

The Contractor shall furnish three copies of purchase orders, mill orders, shop orders and work orders for all materials orders and items used in the work. Where mill tests are required purchase orders shall contain the test site address and the name of the testing agency.

2.1.2 Materials List

The Contractor shall furnish a materials list of the materials to be used in the fabrication of each item.

2.1.3 Shipping Bill

The Contractor shall furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots. Duplicate copies of shipping bills shall be mailed promptly to Resident District Engineer, FM-LVKC, Kansas City District Corps of Engineers, 700 Federal Building, Kansas City, MO 64106 or designated address by the Contracting Officer.

2.2 MATERIALS FOR MISCELLANEOUS METALWORK

Materials and standard articles shall conform to the respective specifications and any specific requirements. Sizes shall be as specified or shown on drawings. Where material requirements are not specified, materials furnished shall be suitable for the intended use and shall be approved by the COR.

2.2.1 Structural Steel

Shall be in accordance with Section, STRUCTURAL STEEL.

2.2.1.1 Stainless Steel Shapes

ASTM A276, Type 316 with a minimum yield strength of 36 ksi.

2.2.1.2 Stainless Steel Plate, Sheet and Strip

ASTM A167, Type 316 with a minimum yield strength of 36 ksi.

2.2.1.3 Fracture Critical Members (FCM)

All steel used in FCM shall have the following notch toughness requirements.

Grade Yield Strength (KSI)	Thickness (inches)	Charpy V-notch (foot-pounds at degrees Fahrenheit)
36	< 4.0	25 at 40
50	< 2.0	25 at 40
70	< 2.5	30 at 20
100	< 2.5	35 at 0

2.2.2 Steel Pipe

ASTM A53, Type E or S, seamless black or galvanized, nominal size and weight class or outside diameter and nominal wall thickness, all as shown on the drawings.

2.2.3 Lead Sheet

Fed. Spec. QQ-L-201, grade as indicated.

2.2.4 Zinc

ASTM B6, grade as indicated.

2.2.5 Stainless Steel Screws, bolts & studs

ASTM A167, Type 316.

2.2.6 Expansion Anchors

Anchors shall be high-strength stainless steel Maxi-Bolt from Drillco National Group, Long Island City, New York, or an approved equal, AISI 316, ASTM A193 with a minimum yield strength of 50 ksi. Anchors shall have a minimum diameter of 5/8 inch and a minimum embedment of 6 inches.

2.2.7 Chains and Attachments

Fed. Spec. RR-C-271.

2.2.8 Floor Gratings (Fabricated)

ANSI/NAAMM MBG 531

2.2.8.1 Description of grating: w - 19 - 4 (1-1/4 x 3/16)

2.2.8.2 Anchorage: As shown on the plans or as recommended by the manufacturer and approved by the COR.

2.2.8.3 Finish: Steel zinc-coated in accordance with ASTM A123 after fabrication, and steel hardware and fasteners completely zinc-coated in accordance with ASTM A153/A153M.

2.2.9 Landing Platforms, Fixed Ladders, Ladder Rungs and Grab Bars

Material for landing platforms, fixed ladders, ladder rungs and grab bars shall meet the requirements of ASTM A36. All ladder rungs shall have a minimum diameter of one inch and Galvanized.

2.2.10 Galvanizing

If specified, galvanizing shall conform to the requirements of either ASTM A123 or ASTM A153, whichever is applicable.

2.2.11 Rail:

Rolling gate rail shall be 104 pound ASCE rail conforming to ASTM A759. Rail clips for rail tie-down shall be Type No. 62, as manufactured by L.B. Foster Co., or an approved equal.

2.2.12 Bituminous Fill

Bituminous concrete fill for rail recesses where shown on the Contract Drawings shall meet requirements of Section, ASPHALTIC CONCRETE INTERMEDIATE LEVELING AND SURFACE COURSES. Material shall be placed and hand-tamped to dimensions and at locations indicated. Where material will contact the face of rail, a tack coat shall be applied to the face of the rail in accordance with Section, BITUMINOUS TACK AND PRIME COATS.

2.2.13 DELETED

2.2.14 Cable

Cables for stoplog storage shall be 1/4-inch diameter strand meeting the requirements of ASTM A586 for zinc-coated steel structural strand, with a Class A coating inner wire and Class C coating outer wires.

2.2.15 Hinges

Hinges shall be wrought steel, sized as shown on the drawings. The hinges shall be furnished blank for welding and shall have corrosion-resistant pins.

2.2.16 Padlocks and Hasps

Padlocks shall be furnished with heavy-duty corrosion-resistant case and shall be keyed alike. The Contractor shall furnish two keys to fit all locks furnished. Hasps shall be wrought steel, sized where required to accommodate padlocks

2.2.17 Ratchet Load Binder

The ratchet load binder shall be a one-piece unit furnished with steel hooks which can be attached to a 1/2-inch chain. The binder shall be ratchet operated capable of a minimum 8-inch take-up.

2.2.18 Shackles and Turnbuckles

Shackles and turnbuckles shall be forged steel in accordance with ASTM A668. Turnbuckles shall be end threaded right- and left-hand and shall be of the size as shown on the contract drawings.

2.2.19 Elastomeric Bearing Pads

Elastomeric bearing pads shall conform to the requirements of AASHTO, Division II, Section 18.

2.2.20 Gratings and Manhole Covers (Manufactured):

Manufactured gratings and manhole covers shall be gray iron castings as recommended by the manufacturers shown on the drawings.

2.3 BOLTING MATERIAL

Bolts, nuts, and washers shall be of the material, grade, type, class, style, and finish indicated or best suited for intended use.

2.3.1 High-Strength Bolts, Nuts, and Washers

ASTM A325.

2.3.2 Bolts, Nuts, and Washers (Other than High-Strength)

2.3.2.1 Bolts and Nuts

ASTM A307, grade A.

2.3.2.2 Bolts

ANSI B18.2.1.

2.3.2.3 Nuts

ANSI B18.2.2.

2.3.2.4 Washers

a. Plain Washers: ANSI B18.22.1, Type B
b. Lock Washer: ANSI B18.21.1.

2.3.2.5 Corrosion-Resisting Bolts and Studs

AISI 316, ASTM A193 Corrosion-resisting nuts with a minimum yield strength of 50 ksi.

2.3.2.6 Welded Studs

ASTM A108.

2.3.3 Screws

Screws shall be of the material, grade, type, style, and finish indicated or best suited for use intended.

2.3.3.1 Cap Screws

ANSI B18.2.1, ANSI B18.3, or ANSI B18.6.2, as required.

2.3.3.2 Machine Screws

ANSI B18.6.3.

2.3.3.3 Set Screws

ANSI B18.6.2.

2.3.3.4 Bronze Fasteners

Bronze fasteners where shown on the contract drawings shall conform to the requirements of ASTM B98, Alloy 655 (Hard).

2.3.3.5 Brass Fasteners

Brass fasteners shall meet the requirements of either ASTM B16 or B21.

2.4 FABRICATION

2.4.1 Structural Fabrication

Fabrication of all parts of the work shall be carefully done in strict accordance with the approved shop drawings. Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

2.4.1.1 Dimensional Tolerances for Structural Work

Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch for members 30 feet 30 feet or less in length and by more than 1/8 inch for members over 30 feet 30 feet in length. Where specific tolerances for an assembled unit are not specified or are not shown on the contract drawings, the Contractor will be held responsible for providing such tolerances that the unit will fit properly and perform the required functions to the satisfaction of the COR. Where the above tolerances for individual component members are not applicable, care shall be taken such that there will not be sufficient cumulative error that the assembled unit does not fit and/or function properly.

2.4.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1 or AWS D1.3. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

2.4.1.3 Structural Aluminum Fabrication

Laying out and cutting of aluminum shall be in accordance with the ADM Aluminum Design Manual and AWS D1.2.

2.4.2 Welding

2.4.2.1 Welding of Fracture Critical Members (FCM)

Welding procedures for FCM shall be qualified in accordance with AASHTO Guide Specifications for Fracture Critical Non-Redundant Bridge Members.

2.4.2.2 Welding of Structural Steel

a. Welding Procedures for Structural Steel - Welding procedures for structural steel shall be prequalified as described in AWS D1.1, or shall be qualified by tests as prescribed in AWS D1.1. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish a welding procedure as prequalified. For welding procedures qualified by tests, the test welding and specimen testing must be witnessed and the test report document signed by the Contracting Officer. Approval of any welding procedure will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Contractor Officer. The Contractor shall submit a complete schedule of welding procedures for each steel structure to be welded. The schedule shall conform to the requirements specified in the provisions AWS D1.1 The schedule shall provide detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint. Welding procedures must include filler metal, preheat, interpass temperature and stress-relief heat treatment requirements. Each welding procedure shall be clearly identified as being prequalified or required to be qualified by tests. Welding procedures must show types and locations of welds designated or in the specifications to receive nondestructive examination.

b. Welding Process - Welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D1.1 or AWS D1.3. Welding shall be such as to minimize residual stresses, distortion and shrinkage.

c. Welding Technique

(1) Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS

specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification allowables is required. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. A controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.1 to maintain low moisture of low hydrogen electrodes.

(2) Preheat and Interpass Temperature - Preheating shall be performed as required by AWS D1.1, or (except as noted on drawings)as otherwise specified except that the temperature of the base metal shall be at least70 degrees F. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

(3) Stress-Relief Heat Treatment - Where stress relief heat treatment is specified or shown, it shall be in accordance with the requirements of AWS D1.1, unless otherwise authorized or directed.

d. Workmanship - Workmanship for welding shall be in accordance with AWS D1.1, and other applicable requirements of these specifications.

(1) Preparation of Base Metal - Prior to welding the Contractor shall inspect surfaces to be welded to assure compliance with AWS D1.1.

(2) Temporary Welds - Temporary welds required for fabrication and erection shall be made under the controlled conditions prescribed for permanent work. Temporary welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Preheating for temporary welds shall be as required by AWS D1.1 for permanent welds except that the minimum temperature shall be120 degrees F in any case. In making temporary welds arcs shall not be struck in other than weld locations. Each temporary weld shall be removed and ground flush with adjacent surfaces after serving its purpose.

(3) Tack Welds - Tacks welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds and shall be cleaned and thoroughly fused with permanent welds. Preheating shall be performed as specified above for temporary welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding.

2.4.2.3 Welding of Steel Castings

Unsound material shall be removed from the surfaces of steel castings to be incorporated into welded connections by chipping, machining, air-arc gouging or grinding. Major connections designed for transfer of stresses shall not be welded if the temperature of the casting is lower than100 degrees F. Castings containing over 0.35 percent carbon or over 0.75 percent manganese shall be preheated to a temperature not to exceed450 degrees F and welding shall be accomplished while the castings are

maintained at a temperature above350 degrees F. Welding will not be permitted on castings containing carbon in excess of 0.45 percent except on written authorization. Castings requiring welding repairs after the first annealing and castings involving welding fabrication shall be stress-relieved annealed prior to receiving final machining unless otherwise permitted.

2.4.2.4 Welding of Aluminum

Welding of aluminum shall conform to AWS D1.2. The welding process and welding operators shall be prequalified as required by AWS D1.2 in accordance with the methods described in ASME BPV IX, Section IX. A certified report giving the results of the qualifying tests shall be furnished for approval. A complete schedule of the welding process for each aluminum fabrication to be welded shall be furnished for approval.

2.4.2.5 Welding of Steel Studs

The procedures for welding steel studs to structural steel and sheet pile, including mechanical, workmanship, technique, stud application qualification, production quality control and fabrication and verification inspection procedures shall conform to the requirements of AWS D1.1, except as otherwise specified.

a. Application Qualification for Steel Studs - As a condition of approval of the stud application process, the Contractor shall furnish certified test reports and certification that the studs conform to the requirements of AWS D1.1, certified results of the stud manufacturer's stud base qualification test, and certified results of the stud application qualification test as required by AWS D1.1, except as otherwise specified.

b. Production Quality Control - Quality control for production welding of studs shall conform to the requirements of AWS D1.1, except as otherwise specified. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production studs (flat, vertical, overhead or sloping). If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

2.4.3 Bolted Connections

2.4.3.1 Bolted Structural Steel Connections

Bolts, nuts and washers shall be of the type specified or indicated. All nuts shall be equipped with washers except for high strength bolts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A 325M ASTM A 325 or ASTM A 490M. ASTM A 490. Slip-critical connections are required where noted on the contract drawings.

a. Bolt Holes - Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

(1) Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger

than the diameter of the bolt.

(2) Holes for fitted bolts shall be match-reamed or drilled in the shop. Burrs resulting from reaming shall be removed. The threads of bolts shall be entirely outside of the holes. The body diameter of bolts shall have tolerances as recommended by ASME B4.1 for the class of fit specified. Fitted bolts shall be fitted in reamed holes by selective assembly to provide an LN-2 fit.

(3) Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.

2.4.3.2 Bolted Aluminum Connections

Punching, drilling, reaming and bolting for bolted aluminum connections shall conform to the requirements of the Aluminum Design Manual.

2.4.4 Machine Work

Tolerances, allowances and gauges for metal fits between plain, non-threaded, cylindrical parts shall conform to ASME B4.1 for the class of fit shown or required unless otherwise shown on approved detail drawings. Where fits are not shown they shall be suitable as approved. Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock shall be allowed on placing pads to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts shall be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be interchangeable with like parts. All drilled holes bolts shall be accurately located.

2.4.4.1 Finished Surfaces

Surface finishes indicated or specified shall be in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified it shall be that which is most suitable for the particular surface, provide the class of fit required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks

which will make the part unsuitable for the intended use will be cause for rejection.

2.4.4.2 Unfinished Surfaces

All work shall be laid out to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in an approved manner.

2.4.4.3 Pin Holes

Pin holes shall be bored true to gauges, smooth, straight and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

2.4.4.4 Gears

Gears shall have machine cut teeth of a form conforming to applicable design requirements of AGMA 2005-B and AGMA 6001-C unless otherwise specified or shown.

2.4.4.5 Shafting

All shafting shall be turned or ground hot-rolled or cold-rolled steel as required unless otherwise specified or authorized. Fillets shall be provided where changes in section occur. Cold-finished shafting may be used where keyseating is the only machine work required.

2.4.4.6 Bearings (not for rolling gates work)

Bearings may be lined with babbit or bronze unless otherwise specified or shown. Where the bearing pressure is in excess of 200 psi, bearings shall be lined with bronze. Pressures on lined bearings shall not exceed 250 psi of projected area unless otherwise required or authorized. Anti-friction bearings of approved types and of sizes not less than those recommended by the bearing manufacturer for the duty intended will be permitted subject to approval. All bearings shall be properly aligned and provided with a suitable means of lubrication. Anti-friction bearings shall be so installed as to provide for retention of the lubricant and to exclude dirt and grit.

2.4.5 Miscellaneous Provisions

2.4.5.1 Metallic Coatings

a. Zinc Coatings - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A 780.

b. Cadmium Coatings - Cadmium coatings shall be of a quality and thickness conforming to the requirements of ASTM B 766 and inspection shall conform to the requirements of ASTM E 165, Type I.

c. Chromium Coatings - Chromium coatings for engineering use shall be applied in conformity with ASTM B 177.

2.4.5.2 Cleaning of Corrosion-Resisting Steel

Oil, paint and other foreign substances shall be removed from corrosion-resisting steel surfaces after fabrication. Cleaning shall be done by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned they shall be given a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. The surfaces shall be visually inspected for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance exist the surface shall be cleaned in accordance with the applicable provisions of ASTM A 380. The proposed method of treatment shall be furnished for approval. After treatment the surfaces shall be visually reinspected. Brushes used to remove foreign substances shall have only stainless steel or nonmetallic bristles. Any contamination occurring subsequent to the initial cleaning shall be removed by one or more of the methods indicated above.

2.4.5.3 Lubrication

The arrangement and details for lubrication shall be as shown. Before erection or assembly all bearing surfaces shall be thoroughly cleaned and lubricated with an approved lubricant.

2.4.6 Shop Assembly

Each machinery and structural unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Assembly and disassembly work shall be performed in the presence of the Contracting Officer unless waived in writing. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the Government. Before disassembly for shipment each piece of a machinery or structural unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

2.4.6.1 Rolling Gates:

Shop Assembly: The bottom truss of each gate, including truss chords, diagonals, wheel support channels (MC12s) and wheel assemblies shall be shop assembled, aligned and match marked in the shop before shipping.

Tolerances: Rail and wheel alignment tolerances shall meet the requirements specified in the contract drawings.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

The Contractor shall have required material tests and analyses performed and certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses shall be performed and certified at the Contractor's expense. Tests, inspections, and verifications shall conform to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Tests shall be conducted in the presence of the Contracting Officer if so required. The Contractor shall furnish specimens and samples for additional independent tests and analyses upon request by the Contracting Officer. Specimens and samples shall be properly labeled and prepared for shipment.

2.5.1 Testing Fracture Critical Members (FCM)

Weld testing, inspection, and personnel qualifications and certification of FCM shall be in accordance with AASHTO Guide Specifications for Fracture Critical Non-Redundant Bridge Members. Copies of the weld inspector's certification and qualifications for all assistant inspectors shall be submitted. All members designated as FCM shall have their joints tested. All complete penetration butt welds shall have radiographic testing; those welds found to be inaccessible to a radiation source or film, or otherwise situated where radiographic examination is not feasible may be examined, with written approval, by dye penetrant, magnetic particle tests, or ultra sonic tests. All other FCM welds shall have ultrasonic testing.

2.5.1 Nondestructive Testing

When doubt exists as to the soundness of any material part such part may be subjected to any form of nondestructive testing determined by the Contracting Officer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Government. Any defects will be cause for rejection and rejected parts shall be replaced and retested at the Contractor's expense.

2.5.2 Tests of Machinery and Structural Units

The details for tests of machinery and structural units shall conform to the requirements of the particular sections of these specifications covering these items. Each complete machinery and structural unit shall be assembled and tested in the shop in the presence of the Contracting Officer unless otherwise directed. Waiving of tests will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that occurs before the completion of the contract or guarantee. After being installed at the site each complete machinery or structural unit shall be operated through a sufficient number of complete cycles to demonstrate to the satisfaction of the Contracting Officer that it meets the specified operational requirements in all respects.

2.5.4 Inspection of Structural Steel Welding

The Contractor shall maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding shall be subject to inspection to determine conformance with the requirements of AWS D1.1, the approved welding procedures and provisions stated in other sections of these specifications.

Nondestructive examination of designated welds will be required. Supplemental examination of any joint or coupon cut from any location in any joint may be required.

2.5.4.1 Visual Examination

All visual examination of completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D1.1 or AWS D1.2, as appropriate. Defects shall be corrected as provided in AWS D1.1 or AWS D1.2, and as required the COR.

2.5.4.2 Nondestructive Examination

The nondestructive examination of shop and field welds shall be performed as designated or described in the sections of these specifications covering the particular items of work.

a. Testing Agency - The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. In either case written approval of the examination procedures is required and the examination tests shall be made in the presence of the Contracting Officer. The evaluation of examination tests shall be subject to the approval and all records shall become the property of the Government.

b. Examination Procedures - Examination procedures shall conform to the following requirements.

(1) Ultrasonic Testing - Making, evaluating and reporting ultrasonic testing of welds shall conform to the requirements of AWS D1.1 or AWS D1.2, as appropriate. The ultrasonic equipment shall be capable of making a permanent record of the test indications. A record shall be made of each weld tested.

(2) Radiographic Testing - Making, evaluating and reporting radiographic testing of welds shall conform to the requirements of AWS D1.1 or AWS D1.2.

(3) Magnetic Particle Inspection - Magnetic particle inspection of welds shall conform to the applicable provisions of ASTM E 709.

(4) Dye Penetrant Inspection - Dye penetrant inspection of welds shall conform to the applicable provisions of ASTM E 165.

c. Acceptability of Welds - Welds shall be unacceptable if shown to have defects prohibited by AWS D1.1 or AWS D1.2, or possess any degree of incomplete fusion, inadequate penetration or undercutting.

d. Welds to be subject to nondestructive examination shall be determined by the COR.

2.5.4.3 Test Coupons

The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved

by nondestructive examination. Should tests of any two coupons cut from the work of any welder show strengths less than that specified for the base metal it will be considered evidence of negligence or incompetence and such welder shall be removed from the work. When coupons are removed from any part of a structure the members cut shall be repaired in a neat manner with joints of the proper type to develop the full strength of the members. Repaired joints shall be peened as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive examination of repairs shall be borne by the Government or the Contractor in accordance with the Contract Clauses INSPECTION AND ACCEPTANCE.

2.5.4.4 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Government.

2.5.5 Welding Repairs

Defective welds in the structural steel welding repairs shall be repaired in accordance with AWS D1.1. Defective weld metal shall be removed to sound metal by use of air carbon-arc or oxygen gouging. Oxygen gouging shall not be used on ASTM A 514/A 514M steel. The surfaces shall be thoroughly cleaned before welding. Welds that have been repaired shall be retested by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting shall be borne by the Contractor. Defective welds in aluminum shall be repaired in accordance with AWS D1.2

2.5.6 Inspection and Testing of Steel Stud Welding

Fabrication and verification inspection and testing of steel stud welding shall conform to the requirements of AWS D1.1, except as otherwise specified. The Contracting Officer will serve as the verification inspector. One stud in every 100 and studs that do not show a full 360 degree weld flash, have been repaired by welding or whose reduction in length due to welding is less than normal shall be bent or torque tested as required by AWS D1.1. If any of these studs fail two additional studs shall be bent or torque tested. If either of the two additional studs fail all of the studs represented by the tests shall be rejected. Studs that crack under testing in either the weld, base metal or shank shall be rejected and replaced by the Contractor at no additional cost.

2.5.7 Handrails

Handrails shall be of the type specified and shown on the drawings and shall be furnished and installed complete with all fittings, brackets, fasteners, sleeves, anchors, and other appurtenances as shown and as required for proper installation.

2.5.7.1 Materials

Steel railings shall be as specified in paragraph, "Steel Pipe." Other appurtenances shall be of the same material as the rails and posts or approved compatible materials. Railings shall be galvanized after

fabrication.

2.5.7.2 Fabrication

Rigid joints in railings shall be welded and shall be flush-finished. Welded joints shall be reinforced with tight-fitting interior sleeves and shall be assembled by welding rails and posts to flush-type fittings, or by mitering and welding joining rails and posts. Slip-on fittings shall be tight-fitting. Fasteners for slip-on fittings shall be the self-locking, concealed type. Expansion joints in railings shall be an inner-sleeved slip-joint, with one end of the sleeve secured to one rail and the ends of the adjoining rails separated a minimum of 1-inch in the installed position. Expansion joints shall be located in rails near the intersection of rails and posts. Bends in railings shall be made in a manner that railings are not crushed and shall maintain their original cross-sectional shape. Welds shall be ground smooth. Railings shall be free of burrs, sharp corners, and sharp edges. Handrails shall be designed to meet EM 385-1-1, US Army Corps of Engineers, Safety and Health Requirements Manual and OSHA requirements. The design shall include a design working load of 200 pounds applied in any direction at any point on the top rail without exceeding the specified minimum yield stress at any point in any cross-section of the rail system. Design of the rail anchorage shall include the 200-pound load applied to the rail. Design calculations must be submitted and approved prior to installation.

2.5.7.3 Installation

Railings shall be installed as specified and shown on the drawings. Railing posts anchored to concrete surfaces perpendicular to the posts shall be set in pipe sleeve inserts with a steel plate welded to the bottom of the sleeve, and anchored in the concrete. The space between posts and sleeves shall be filled with non-shrink grout in accordance with Section, CAST-IN-PLACE CONCRETE FOR CIVIL WORKS, and covered with standard collar fittings secured to the posts. A 1/4-inch drain hole shall be drilled near the bottom of each post.

2.5.8 Gratings (Fabricated)

Grating shall be of the material and size shown on the drawings, and shall be fabricated in sectional panels of the width and length shown on the drawings or as appropriate, to accurately fit within the supporting recess frames. Openings through panels shall be provided as shown on the drawings or as required. Hinged panels shall be provided with hinges of the type shown on the drawings or suitable for the application. Steel gratings shall be galvanized after fabrication. Edges of gratings and openings through gratings which require the cutting of more than one bearing bar shall be banded. Fasteners shall be of the type recommended by the manufacturer and approved by the COR.

2.5.9 Recess Frames

Recess frames shall be fabricated of structural shapes. The anchorage design drawings and details shall be submitted by the Contractor for approval by the COR. Welded joints in frames shall be ground smooth. Steel frames shall be galvanized after fabrication. Frames shall be anchored to supports in the manner shown on the drawings and shall not be continuous across contraction or expansion joints.

2.5.10 Ladder Rungs and Grab Bars

Ladder rungs and grab bars shall be fabricated from steel rods in accordance with the details shown on the drawings and shall be galvanized after fabrication.

2.5.10.1 Ladders

Ladders shall be fixed-rail metal ladders conforming to the requirements of EM 385-1-1 and to details shown. Ladders shall be fabricated of structural steel as shown and shall be galvanized after fabrication. Fabrication of ladders shall consist of solid-section rod rungs fitted into holes in bar side rails and welded. Splices in side rails shall be made using full penetration welds and shall provide a flush and smooth transition between connecting ends. All welds shall be ground smooth Ladder rails shall be welded to bent-bar supporting brackets anchored to supporting structure as shown.

Fixed Ladders:

Ladders shall be fixed-rail metal ladders conforming to the requirements of EM 385-1-1 and to details shown. Welding shall be in accordance with AWS D1.1 Ladders shall be fabricated of structural steel as shown and shall be galvanized after fabrication. Fabrication of ladders shall consist of solid-section rod rungs fitted into hole in bar side rails and welded. Splices in side rails shall be made using full penetration welds and shall provide a flush and smooth transition between connecting ends. All welds shall be ground smooth. Ladder rails shall be welded to bent-bar supporting brackets anchored to supporting structure as shown. Fixed ladders shall be fabricated of structural shapes of the type shown on the drawings and shall be galvanized after fabrication. Fixed ladders shall be provided for gatewell #3.

Ladder Safety Devices:

A ladder safety device system consisting of the materials and of the type system specified and shown on the drawings shall be furnished and installed complete as required for proper installation. A complete ladder safety device system shall be installed on each fixed ladder at the locations sited in paragraph titled "Fixed Ladders".

Ladder Safety Device system consists of a stainless steel rail, stainless steel rung clamps to attach rail to rungs of fixed ladder, stainless steel removable ladder extension, detachable sliding sleeve and climbing harness for 2000 Climb-Rite Fall Protection System as produced by Sellstrom Manufacturing Company, One Sellstrom Drive, Palatine, Illinois, or approved equal.

2.5.11 Embedded Items

Armor angles, armor plates, frames and miscellaneous steel embedded items shall be fabricated and erected true to line and grade. Edges of exposed faces may have a vertical or horizontal distortion from a straight line not greater than 0.025 inch per foot of length provided that the distortion for any single piece shall not exceed 1/4-inch. Length deviation of assemblies shall not be cumulative error so that the unit does not fit or function as shown on the contract drawings. Plates shall be flat, not varying from a true surface by more than 1/8-inch at any point. Unless specified to be galvanized or stainless steel, all surfaces shall be given a primer coat of

the required paint prior to installation. Exposed surfaces shall then be field painted with required finish coats. Stoplog sill and seal plates shall meet the dimensional tolerances of paragraph titled " Construction Tolerances, Section: 03301.

2.5.12 Finish Surfaces

Finishes shall in general conform to the requirements of the paragraph, "Machine Work" of Section,METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS, and as further specified herein.

Contact surfaces of steel plates or bars used for clamping the rubber J-seals in proper position shall be surface finished to a roughness value of 125 micro-inches in accordance with the provision of ASME B46.1.

2.5.13 Painting

Painting shall be in accordance with Section, PAINTING:HYDRAULIC STRUCTURES.

2.5.14 Gratings and Manhole Covers (Manufactured):

Manufactured grating and frame shall be used for Grate Inlet (GI-14). Manufactured manhole cover and frame shall be used for Curb Inlet (CI-13), Gate Structure (GS-3), Existing Manhole (EXMH-28), Field Inlet (FI-1) and Existing Curb Inlets (EXCI-6 and EXCI-12). For size and type, see details on the drawings.

2.5.15 Landing Platforms

Landing platforms and appurtenances shall be designed to meet EM 385-1-1, US Army Corps of Engineers, Safety and Health Requirements Manual and OSHA requirements. The landing platforms shall also be designed for the loads specified herein. The platform and platform supports shall be designed for working loads as follows: a uniform vertical load of 100 pounds per square foot and a concentrated vertical load of 300 pounds each applied at the platform level. The uniform load and the concentrated load may be applied independently. The concentrated load shall be applied at locations which provide maximum stress in each individual member of the platform and platform supports. The platform deck shall be composed of steel grating as specified in paragraph, "Floor Gratings (Fabricated)". The handrail design shall include a design working load of 200 pounds applied in any direction at any point on the top rail without exceeding the specified minimum yield stress at any point in any cross-section of the rail and platform system. Design of the rail anchorage and the platform support shall include the 200-pound load applied to the rail. The handrail load shall be applied concurrent with the platform loads. Maximum deflection of the platform shall not exceed 1/4-inch. Anchorage to the wall shall be designed using expansion anchors as specified in paragraph, "Expansion Anchors". The platform frame and handrail may be welded and/or a bolted unit; however, the unit must be capable of removal through the entrance hatch either as a unit or as an assemblage. Design calculations must be submitted and approved prior to installation.

PART 3 EXECUTION

3.1 INSTALLATION

Installation and erection of all parts of this work shall be in accordance

with the approved shop drawings, erection diagrams or working drawings.

All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut the half nut shall be placed first and followed by the full nut. Threads of all bolts except high strength bolts, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

3.1.1 Alignment and Setting

Each machinery or structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Machines shall be set true to the elevations shown.

3.1.2 Blocking and Wedges

All blocking and wedges used during installation for the support of parts to be grouted in foundations shall be removed before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval shall be of steel or iron.

3.1.3 Foundations and Grouting

Concreting of subbases and frames and the final grouting under parts of machines shall be in accordance with the procedures as specified in Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.2 PROTECTION OF FINISHED WORK

3.2.1 Machined Surfaces

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Finished surfaces of metals which shall be exposed after installation except corrosion resisting steel or nonferrous metals shall be painted as specified in Section, PAINTING: HYDRAULIC STRUCTURES.

3.2.2 Lubrication After Assembly

After assembly all lubricating systems shall be filled with the lubricant specified and additional lubricant shall be applied at intervals as required to maintain the equipment in satisfactory condition until acceptance of the work.

3.2.3 Aluminum

Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. The zinc-chromate primer shall conform to SAE AMS 3110. The aluminum paint shall consist of a aluminum paste conforming to ASTM D 962, spar varnish conforming to SAE AMS 3132 and thinner compatible with the varnish. The aluminum paint shall be field mixed in proportion of2 pounds of paste, not more thanone gallon of spar varnish and not more thanone pint of thinner.

3.3 CORNER PROTECTION AND ARMOR ANGLES AND PLATES

Steel wall armor and protection angles and plates required at the gate post concrete for the rolling gate closures, for the stoplog gap guides, and stoplog post guides shall be set in the forms true to line and grade. All wall armor shall be given a primer coat of the required paint on all surfaces prior to installation in the forms.

3.4 PAINTING

Corrosion-resisting surfaces, rubber seals, bearing surfaces, machined surfaces and surfaces specified to be galvanized shall not be painted. The surfaces of the rolling gates, including brackets, wheels (except tread), and miscellaneous appurtenances shall be painted as specified in Section, PAINTING: HYDRAULIC STRUCTURES.

3.5 TESTS

3.5.1 Workmanship

Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

3.5.2 Production Welding

Production welding shall conform to the requirements of AWS D1.1 or AWS D1.2 as applicable. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

-- End of Section --

SECTION 05120

STRUCTURAL STEEL
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC ASD Mnl	(1989) Manual of Steel Construction Allowable Stress Design
AISC ASD/LRFD Vol II	(1992) Manual of Steel Construction Vol II: Connections
AISC Design Guide #10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC LRFD Vol I	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol I: Structural Members, Specifications & Codes
AISC LRFD Vol II	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II: Structural Members, Specifications & Codes
AISC Pub No. S303	(1992) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1997) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1997) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 242/A 242M	(1993a) High-Strength Low-Alloy Structural Steel

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 490	(1997) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(1996) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1996) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 502	(1993) Steel Structural Rivets
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(1997) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 618	(1996) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 709/A 709M	(19997a) Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 852/A 852M	(1997) Quenched and Tempered Low-Alloy

	Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(1996) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM A992/A992M	(1998) Steel for Structural Shapes for Use in Building Framing

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1	(1994) Lock Washers (Inch Series)
ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1993) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(1996) Structural Welding Code - Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Mnl and AISC LRFD Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC ASD Mnl and AISC ASD/LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1. High-strength bolting shall be in accordance with AISC ASD Manual. Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS provides addtional requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-04 Drawings

Structural Steel System; GA-RE. Structural Connections; GA-RE.

Shop and erection details including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

SD-08 Statements

Erection; GA-RE.

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

SD-13 Certificates

Mill Test Reports; GA-RE.

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.

Welder Qualifications; GA-RE.

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

Fabrication; GA-RE.

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

SD-14 Samples

High Strength Bolts and Nuts; GA-RE. Carbon Steel Bolts and Nuts; GA-RE. Nuts Dimensional Style; GA-RE. Washers; GA-RE.

Random samples of bolts, nuts, and washers as delivered to the job site if requested, taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

1.5 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the structural steel is incidental.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

For Plates, Bars and Angles.
Carbon grade steel shall conform to ASTM A 36/A 36M.

2.1.2 High-Strength Low-Alloy Steel

High-strength low-alloy steel shall conform to ASTM A 572/A 572M, Grade 50 or ASTM A992/A992M.

2.1.3 Corrosion-Resistant High-Strength Low-Alloy Steel

Corrosion-resistant steel shall conform to ASTM A 242/A 242M.

2.1.4 Quenched and Tempered Alloy Steel

Tempered alloy steel shall conform to ASTM A 514/A 514M.

2.1.5 Carbon and High-Strength Low-Alloy Steel

Carbon and high-strength low-alloy steel shall conform to ASTM A 709/A 709M.

2.1.6 Quenched and Tempered Low-Alloy Steel

Quenched and tempered low-alloy steel shall conform to ASTM A 852/A 852M, 70 ksi.

2.1.7 Structural Shapes

Structural shapes in accordance with ASTM A 6/A 6M shall be used.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade B .

2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Type E Type S or Grade B as shown on the drawings.

2.4 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325, Type 1 with carbon steel nuts conforming to ASTM A 563, Grade C .

2.5 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563, Grade A.

2.6 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Heavy Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325 or ASTM A 490 bolts.

2.7 WASHERS

Plain washers shall conform to ASTM F 844. Other types, when required, shall conform to ASME B18.21.1 .

2.8 PAINT

Paint shall conform to Section, PAINTING: HYDRAULIC STRUCTURES.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Mnl. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category Supplement structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type (slip-critical) high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

3.2 ERECTION

a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC LRFD Vol I . Erection plan shall be reviewed, stamped and sealed by a structural engineer licensed by the state in which the project is located.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC Pub No. S303 and the structure shall be erected in accordance with AISC Design Guide #10.

3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

3.2.2 Base or Bearing Plates & Similar Members Type Applications

Column base plates for columns and bearing plates for beams, girders, and similar members type of applications shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

-- End of Section --

SECTION 05900

FLAP GATES MISCELLANEOUS DRAINAGE STRUCTURES
10/99

PART 1 GENERAL

The work covered by this section consists of furnishing all plant, labor, material and equipment to furnish, fabricate, and install flap gates with all appurtenances necessary to form a complete and workable installation as specified herein and shown on the contract drawings.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM B98	Copper-Silicone Alloy Rod, Bar, and Shapes
ASTM B584	Copper Alloy Sand Castings for General Applications
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

Text explaining details of information to be submitted.

SD-01 Data

Flapgate Design; GA-RE.

The complete manufactures design and calculations of the flap gate shall be submitted for approval prior to installation.

Lists of Materials; GA-RE.

The Contractor shall furnish three copies of all purchase and mill orders, shop orders and work orders. The Contractor shall furnish a list designating the material to be used for each item at the time of

submittal of shop drawings. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. The Contractor shall also furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each piece, the number of pieces, the total weight and the car initial and number.

SD-04 Drawings

Shop Drawings; GA-RE.

Complete shop drawings and erection drawings for the flap gates and appurtenant items shall be submitted for approval in accordance with Section, STRUCTURAL STEEL, prior to fabrication of any gate. Drawings shall include catalog cuts, templates, fabrication, erection and assembly details, and grade and class of materials. Elements of fabricated items inadvertently omitted from contract drawings shall be indicated on the submittals.

SD-13 Certificates

Certification of Material tests and Analyses; GA-RE.
Certification; GA-RE.

Manufacture's certification of flap gates, wall thimbles and attachment accessories furnished for this contract fully meets the requirements of the contract.

Certification of material tests and analyses and examinations shall be submitted in triplicate for approval. Test reports for material tests and analyses shall be identified with specific lots and items prior to installation.

1.3 QUALITY CONTROL

1.3.1 General

The Contractor shall establish and maintain quality control for the work specified in this section to assure compliance with the contract requirements and shall maintain detailed records of his quality control for construction operations including, but not limited to, the following:
(a) Material;
(b) Fabrication and workmanship;
(d) Welding; and
(d) Installation.

1.3.2 Certification

The Contractor shall certify that all materials, either specifically manufactured for this work or manufactured as a stock item, conform to the requirements of these Specifications. Such certification will not relieve the Contractor of responsibility for any fault in operation, workmanship, or material that may develop before the completion of his work or guarantee.

1.3.3 Workmanship

1.3.3.1 General

Workmanship shall be of the highest grade in accordance with the best modern practices to conform to the specifications for the item of work being furnished.

1.3.3.2 Commercial Equipment

Commercial equipment furnished under this contract, but not designed especially for this particular project, shall be the standard product of a manufacturer regularly engaged in the manufacture of equipment of this type; of current manufacture; new and unused; built on the multiple or repetitive system; and suitable for the intended use. The provisions of this section shall not apply to the manufacture of the items themselves, except as specifically directed by the COR.

1.4 DESIGN

Flap gate accessories shall be standard of the manufacture. All flap gate parts shall be designed with a minimum factor of safty of five. The flap gate leaf and frame shall be of cast-iron construction with ribbed reinforcing designed to withstand the seating head specified. The gate shall be of double-hinged type with bronze seat rings and bronze disc rings constructed to seat properly when the pipe axis is inclined 3 degrees. The design of the gate shall be such that the flap cannot be opened to the extent that it will not close by its own weight, and such that the flap cannot become lodged in the opening of the frame. The hinge pins for the upper and lower pivot points shall be in double shear, and the hinge link arms provided with bossed bearing areas. The upper pivot point shall be adjustable and the contacting machined surface between flap and frame shall form a mating low leakage closure, which at no point shall exceed a .004-inch gap. Provision shall be made for adequate lubrication of the hinge pins, either by means of permanently-lubricated bearings or by means of suitable bronze bushings equipped with lubrication fittings. The complete design of flap gate shall be submitted to the COR for approval.

The flap gates shall be of the sizes and types specified below. All components shall be adequate to withstand, without breakage or deleterious deformation, all stresses encountered during installation or operations under the conditions specified. All components shall be manufactured under the principal of interchangeability. Where a flat frame is furnished, it shall be connected to a cast-iron wall thimble designed for connection to the gate frame.

1.5 Levee 385 Major Flap Gate Table

Levee 385 Major FLAP GATE location.

Quantity, size, type and location of all gates are shown the drawings.

Installation Location Structure for Gatewell No.	Type and Size Pipe	Seating Head	Type Frame
QL GW 2	48" RCP	25 ft	flat
RL 3	18" RCP	20 ft	"
QL GW 4	60" RCP	29 ft	"

Levee 385 Major FLAP GATE location.			
QL GW 4A	48" RCP	22 ft	"
QL GW 5A	60" RCP	34 ft	"
RL GW 7	36" RCP	33 ft	"
RL GW 8	42" RCP	39 ft	"
RL GW 10	48" RCP	22 ft	"
RL GW 11	78" RCP	31 ft	"
JB 19	36" RCP	36 ft	"
Quindaro Pump Station	108" RCP	34 ft	"
Modified Grate inlet (GI-20)	18" DIP	19.1 ft	flat back with wall thimble
Outlet Structure for Drainage System #8	60" RCP	33.6 ft	flat back with wall thimble

1.6 Thimble

Where a flat frame is furnished, it shall be connected to a cast-iron wall thimble designed for connection to the gate frame. Where a flange is to be encased in concrete and is furnished for stud bolts, the threaded bolt holes shall be plugged at the back of the flange with corks which shall project into the concrete a minimum of ~~ inch. Where no attachment is to be made and no studs are furnished, the holes shall be cleaned and filled with an approved bituminous caulking compound. The flanges shall be placed plumb. Any flanges provided with holes drilled in conformance with USASI (ASA) Standing Drilling (piping standards) shall be placed with th' bolt holes straddled equidistant from the vertical and horizontal centerlines.

Wall thimbles shall be as specified under Section, SLUICE GATES - MISCELLANEOUS DRAINAGE STRUCTURES.

1.7 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 MATERIALS

Flap gate leaf and frame shall be cast iron, conforming to ASTM A126, Class B.

Hinge pins shall be silicon bronze conforming to ASTM B98, Alloy 655, or stainless steel conforming to ASTM A276, Type 304.

Hinge arms shall be high-tensile bronze, ASTM B584, Alloy 865.

Fasteners, including anchor bolts, shall be stainless steel conforming to ASTM F593, Type 304. Nuts shall be silicon bronze meeting ASTM B98, Alloy 655.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Painting

All cast iron and steel parts (except stainless steel and galvanized steel) shall be painted with a corrosion resistant paint. Painting shall be in accordance with Section, PAINTING: HYDRAULIC STRUCTURES. Color shall be subject to the approval of the COR.

3.2 STORAGE

Upon delivery to the work site, storage may be outdoors provided such storage is on wood blocking not less than 8 inches above a base of washed gravel or crushed stone not less than 2 inches thick.

3.3 FIELD INSTALLATION AND TESTS

3.2 Installation

Installation shall be as indicated on the drawings and in accordance with instructions of the manufacturer, and shall include the flap gate structure, new R.C.P., and all appurtenances related to the installation of the flap gate.

3.3 Tests

The gate shall be operated and tested by and at the expense of the Contractor and to the satisfaction of the COR, to determine that the gate has been properly manufactured, assembled, and installed and meets the requirements of the specifications. The Contractor shall notify the COR at least 5 days prior to testing. Any malfunction or discrepancy will be remedied by the Contractor at no expense to the Government.

3.4 GUARANTEE

Equipment furnished under this specification section shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, design and workmanship. Upon receipt of notice from the Government of failure of any part of the guaranteed equipment during the guarantee period, a new replacement part or parts shall be furnished and installed promptly by the Contractor at no additional cost to the Government.

-- End of Section --

SECTION 05901

TRASH RACKS
07/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 283	(1993a) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 653	(1996) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924	(1996a) Steel Sheet, Metallic-Coated by the Hot-Dip Process

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-04 Drawings

Trash Racks; GA-RE.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the trash racks

SD-14 Samples

Miscellaneous Metal Items; GA-RE.

Samples of all steel materials. Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in

the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified. See specification Section, PAINTING: HYDRAULIC STRUCTURES.

PART 2 PRODUCTS

2.1 MISCELLANEOUS

Miscellaneous plates and shapes for items that do form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the design requirements. Tests, workmanship and other applicable quality control requirements for quality assurance and installation for materials and items contained herein shall be as specified in Section, STRUCTURAL STEEL.

3.2 Painting

See Section PAINTING: HYDRAULIC STRUCTURES for painting requirements

-- End of Section --

PHASE II

DIVISION 6 – WOOD AND PLASTICS

06710 Vinyl Sheet Piling

SECTION 06710

VINYL SHEET PILING

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all submittals, labor, equipment, plant, materials, and all efforts necessary for vinyl sheet piling acquisition and installation as defined for this project. Vinyl sheet piling is a Contractor requirement for permanent seepage control beneath the Q2 gap pile cap. Vinyl sheet piling interlocks shall be compatible with the adjacent steel sheet piling interlocks in line with the vinyl sheet piling or the Contractor may use field joint fabrication as indicated in the drawings.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION FOR TESTING AND MATERIALS (ASTM)

ASTM D-638	(1999) Tensile Properties of Plastics
ASTM D-790	(1999) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials
ASTM D 4216	(1998) Rigid Poly (Vinyl Chloride) (PVC) and Related Plastic Building Products Components
ASTM D-4226	(1999) Impact Resistance of Rigid Poly (Vinyl Chloride) (PVC) Building Products

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-08 Statements

Plan of Operations ; GA-GL.

A detailed plan of operations shall be submitted to the Contracting Officer Representative (COR) and work shall not begin until the submittal has been approved. The submittal shall include, as a minimum, acquisition, storage, protection, and installation of vinyl sheet piling. Installation shall include method of embedment into the ground; method of connection to

adjacent steel sheet piling, where appropriate; and, layout of the vinyl sheet piling relative to the project features. The Plan of Operations shall include a section describing the proposed method of mitigation should voids develop during driving between the sheet piling and the soil. Grouting will be considered an acceptable mitigation technique. Should the Contractor wish to pursue the grouting option, the Plan of Operations shall contain a section describing the proposed grout type, the grout mix, and the proposed method of placement for the Contracting Officer's review and approval.

Conformance With Specification Certification;GA-GL

The Contractor shall provide written certification stamped by a professional engineer registered in the State of Missouri stating that the vinyl sheet piling provided for this contract meets or exceeds the requirements of this specification section. This certification shall include a listing of the requirements.

SD-14 Samples

Vinyl Sheet Piling Sample;GA-GL

A sample of the vinyl sheet piling shall be submitted as well as a specification sheet on the vinyl sheet piling to be used for the seepage cut-off. The sample and specification sheet shall demonstrate compliance with the requirements of these plans and specifications and minimum requirements necessary for the approved installation method. Vinyl sheet piling shall not be acquired and brought on site until the material is approved by the COR.

1.4 VINYL SHEET PILING STORAGE, HANDLING, AND PROTECTION

Vinyl sheet piling shall be stored and handled in accordance with the manufacturer's recommendations. Vinyl sheet piling storage and handling shall be addressed in the Contractor's Plan of Operations submittal and shall reference specific manufacturer's recommendations. Ultraviolet inhibitor within the vinyl sheet piling will not be required. However, until the vinyl sheet piling is embedded in the earth, the vinyl sheet piling shall be protected against exposure to ultraviolet rays. The duration of exposure to ultraviolet rays shall not exceed the manufacturer's recommendations. Vinyl sheet piling exceeding the manufacturer's ultraviolet exposure duration limit or damaged during shipment, storage, handling, or other means shall be immediately removed from the project site. Vinyl sheet piling damaged during installation shall be removed from the ground and immediately removed from the project site. Damaged vinyl sheet piling or vinyl sheet piling exceeding manufacturer's limits for ultraviolet exposure shall be replaced, and reinstalled, as appropriate, at no cost to the Government.

1.5 SUBSURFACE INFORMATION

The Contractor shall review and become familiar with subsurface conditions where the vinyl sheet piling is to be installed and account for the subsurface conditions in the Plan of Operations' sections on installation and protection of the vinyl sheet piling.

PART 2 PRODUCTS

2.1 GENERAL

The Contractor is responsible for providing vinyl sheet piling that meets the requirements of these plans and specifications and as necessary to meet the minimum requirements for the approved installation procedure. Requirements in these plans and specifications shall be considered the minimum requirements. A certification stamped by a professional engineer registered in the State of Missouri shall be provided by the Contractor stating the vinyl sheet piling meets or exceeds the requirements of this specification section. This certification shall include a listing of the requirements.

2.2 VINYL SHEET PILING

2.2.1 Minimum Requirements

Vinyl sheet piling shall be commercial grade and co-extruded with the Z or U-type section configuration conforming to ASTM D 4216. Vinyl sheet piling shall be rigid, impact modified, and have a weatherable virgin capstock. The sheet piling shall have a minimum section depth of 7 inches but not to **exceed 9 inches**. The minimum web and outer flat thickness shall be 0.250 inches. The vinyl sheet piling shall have a minimum warranty of 50 years against measurable degradation of physical dimensions or composition, strength, and ductility. Series 300, ShoreGuard vinyl sheet piling manufactured by Materials International, Inc. of Atlanta, Georgia or equivalent having the following material properties, shall be used for this project.

Vinyl Sheet Pile Properties

Property	Units	Value
Design Strength	Pounds/Sq. Inch	2,667
Impact Strength	In.-Lbs./Sq. Inch	13,750
Strength Rating	Ft. Lbs./Linear Ft.	2,889
Weight/Foot	Pounds	3.2
Nominal Thickness	Inches	0.250
Section Modulus	Cubic In./Linear Ft.	13
Modulus of Elasticity	Pounds/Sq. Inch	380,000
Tensile Strength	Pounds/Sq. Inch	6,300

Modulus of elasticity shall be as measured according to ASTM D-790. Tensile Strength shall be as measured according to ASTM D-638. Impact Strength shall be as measured according to ASTM D-4226.

2.2.2 Additional Requirements

In addition to the minimum requirements, vinyl sheet piling shall also comply with the minimum manufacturer's requirements for the approved installation procedure. The Contractor shall ensure the additional requirements do not violate the minimum requirements of Part 2, paragraph, "General" of this specification section and shall ensure compliance with manufacturer's recommendations when developing the vinyl sheet pile installation procedure.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall be responsible for the proper installation of the vinyl sheet piling. The vinyl sheet piling shall be handled and installed in accordance with the requirements of these plans and specifications and with the manufacturer's recommendations. Selection of the vinyl sheet piling shall be such as to not violate the requirements of these plans and specifications. Installation shall be to the limits shown in the drawings: layout and connections shall be such to ensure continuity throughout the length of the combined vinyl and steel sheet piling system.

3.2 EQUIPMENT

Equipment proposed for installation of vinyl sheet piling shall be identified in the Plan of Operations. If the vinyl sheet piling is to be driven into position, a template shall be provided by the Contractor for the installation per the manufacturer's recommendations. An installation mandrel will be allowed for the installation of the vinyl sheet piling. The "Stompper" mandrel manufactured by Stab Cat of Louisiana, Plaquemine, LA, or equivalent as approved by the Contracting Officer, may be utilized by the Contractor for this project.

3.3 INSTALLATION

Installation shall include the placement of continuous lengths of vinyl sheet piling extending from an elevation of 6-inches below the base of pile cap elevation to the tip elevations as indicated on the drawings. The vinyl sheet piling shall be installed into a pre-excavated surface trench having a depth of 12-inches as measured from the base of pile cap elevation and a width sufficient to allow 6-inches of clear space between the edges of the installed vinyl sheet piling and the trench walls. Project drawings shall be referenced by the Contractor for other details of the trench dimensions, backfilling requirements, and trench completion prior to placement of pile cap concrete. Field fabrication of vinyl to vinyl sheet piling horizontal couplings shall not be allowed. For vinyl to steel sheet piling connections the Contractor has the option of selecting vinyl and steel sheet piling having compatible interlocks or the Contractor may choose to field manufacture a connection as indicated on the drawings. The Contractor shall allow for extra pile length as necessary for sacrifice due to damage from the installation. Sacrificial lengths shall not be considered part of the pay item. The installation method shall be proposed by the Contractor in the Plan of Operations. The installation method proposed shall not result in voids or gaps between the vinyl sheet piling and the soil, shall not result in reduced subsurface soil density, and shall not promote fracturing or heave of the subsurface soils. Grouting will be considered acceptable to mitigate voids developing during sheet piling installation upon successful demonstration of complete filling without detriment to the subsurface. The proposed grout type, mix, and placement technique shall be included as part of the Plan of Operations.

3.4 CONNECTIONS

The Contractor shall include in the Plan of Operations a proposed detail for the vertical coupling of vinyl to steel sheet piling. A field fabrication detail is included in the drawings and will be considered an acceptable procedure for vertical coupling of vinyl to steel.

-- End of Section --

PHASE II

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

NOT APPLICABLE

PHASE II

DIVISION 8 – DOORS AND WINDOWS

NOT APPLICABLE

SECTION 08310

HORIZONTAL ACCESS DOOR

PART 1 GENERAL

1.1 REFERENCES

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-106 (1996) Standard Door Type Nomenclature

1.2 PRODUCT HANDLING

All materials shall be delivered in manufacturer's original packaging.

Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

Remove protective wrapping immediately after installation if applicable.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having a "GA" designation are for information only. When used, a designation following the "GA" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Design Calculations; GA-AE.

The Contractor shall submit the manufacturer's design calculations clearly defining all requirements specified herein and shown on the contract drawings.

SD-04 Drawings

Steel Doors and Frames; GA-AE.

Drawings using standard door type nomenclature in accordance with SDOI SDI-106 indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of metal. Drawings shall include catalog cuts or descriptive data for the doors, frames, and weatherstripping including air infiltration data and manufacturers printed instructions.

1.4 SUBSTITUTIONS

Proposals for substitution products shall be accepted only from bidding contractors and not less than (10) working days before bid due date. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.5 JOB CONDITIONS

Verify that other trades with related work are complete before installing vault access door(s).

Mounting surfaces shall be straight and secure; substrates shall be of proper width.

Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

Observe all appropriate OSHA safety guidelines for this work.

1.6 WARRANTY/GUARANTEE

Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of (5) five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

1.7 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 ACCESS DOOR

Furnish and install where indicated on plans vault access door Bilco Type JD-AL H20 or approved equal, size as indicated on the plans. The vault access door shall be pre-assembled from the manufacturer. Double leaf doors shall be without center mullion.

2.1.1 Performance characteristics

a. Covers: Shall be reinforced to support AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span. Manufacturer to provide structural calculations stamped by a registered professional engineer upon request.

b. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

c. Operation of the covers shall not be affected by temperature.

d. Entire door, including all hardware components, shall be highly corrosion resistant. Please consult the manufacturer when doors are to be installed in unusually harsh environments or extremely corrosive conditions.

2.1.2 Covers

Shall be 1/4" aluminum diamond pattern.

2.1.3 Frame

Channel frame shall be 1/4" extruded aluminum with bend down anchor tabs around the perimeter. A continuous EPDM gasket shall be mechanically attached to the aluminum frame to create a barrier around the entire perimeter of the cover and significantly reduce the amount of dirt and debris that may enter the channel frame.

2.1.4 Drain Coupling

Provide a 1-1/2" drain coupling located in the right front corner of the channel frame.

2.1.5 Lifting Mechanisms

Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4" gusset support plate.

A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the covers and the latch release shall be protected by a flush, gasketed, removable screw plug.

2.1.6 Hardware

a. Hinges: Heavy forged aluminum hinges, each having a minimum 1/4" diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.

2.1.6.1 [Enter Appropriate Subpart Title Here]

Hinges shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

b. Covers shall be equipped with an hold open arm which automatically locks the covers in the open position.

c. Covers shall be fitted with the required number and size of compression spring operators. Springs shall have an electrocoated acrylic

finish. Spring tubes shall be constructed of a reinforced nylon 6/6 based engineered composite material.

d. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

e. Hardware shall be anticorrosion throughout.

2.1.7 Finishes

Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

PART 3 EXECUTION

3.1 INSPECTION

Verify that the vault access door installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

The installer shall check existing conditions and verify the manufacturer's vault access door details for accuracy to fit the application prior to fabrication. The installer shall comply with the vault access door manufacturer's installation instructions.

The installer shall furnish mechanical fasteners consistent with the vault access door manufacturer's instructions.

-- End of Section --

PHASE II

DIVISION 9 – FINISHES

09965 Painting: Hydraulic Structures

SECTION 09965

PAINTING: HYDRAULIC STRUCTURES
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z87.1	(1989; Errata; Z87.1a) Occupational and Educational Eye and Face Protection
ANSI Z358.1	(1990) Emergency Eyewash and Shower Equipment

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 153	(1984; R 1996) Specific Gravity of Pigments
ASTM D 235	(1995) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 281	(1995) Oil Absorption of Pigments by Spatula Rub-Out
ASTM D 304	(1995) N-Butyl Alcohol (Butanol)
ASTM D 520	(1984; R 1995) Zinc Dust Pigment
ASTM D 561	(1982; R 1996) Carbon Black Pigment for Paint
ASTM D 740	(1994) Methyl Ethyl Ketone
ASTM D 770	(1995) Isopropyl Alcohol
ASTM D 841	(1995) Nitration Grade Toluene
ASTM D 843	(1995) Nitration Grade Xylene
ASTM D 962	(1981; R 1994) Aluminum Powder and Paste Pigments for Paints
ASTM D 1045	(1995) Sampling and Testing Plasticizers Used in Plastics
ASTM D 1152	(1989; R 1993) Methanol (Methyl Alcohol)
ASTM D 1153	(1994) Methyl Isobutyl Ketone
ASTM D 1186	(1993) Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings

	Applied to a Ferrous Base
ASTM D 1200	(1994) Viscosity by Ford Viscosity Cup
ASTM D 1210	(1996) Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
ASTM D 1400	(1994) Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base
ASTM D 1763	(1994) Epoxy Resins
ASTM D 2917	(1991; R 1994) Methyl Isoamyl Ketone
ASTM D 3721	(1983; R 1991) Synthetic Red Iron Oxide Pigment
ASTM D 4360	(1990; R 1995) Methyl n-Amyl Ketone
ASTM D 4417	(1993) Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM E 1347	(1997) Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1910.94	Ventilation
29 CFR 1910.139	Respiratory Protection
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910, Subpart I	Personal Protective Equipment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.62	Lead
40 CFR 50.6	National Primary and Secondary Ambient Air Quality Standards for Particulate Matter
40 CFR 50.12	National Primary and Secondary Ambient Air Quality Standards for Lead
40 CFR 50, App B	Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere
40 CFR 58, App E	Probe Siting Criteria for Ambient Air Quality Monitoring

40 CFR 60, App A, Mtd 22	Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares
40 CFR 117	Determination of Reportable Quantities for Hazardous Substances
40 CFR 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 261, App III	Chemical Analysis Test Methods
40 CFR 261, App II, Mtd 1311	Toxicity Characteristic Leaching Procedure (TCLP)
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 262.22	Number of Copies
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
49 CFR 171, Subchapter C	Hazardous Materials Regulations

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2246	(Rev B) Paint, Latex
CID A-A-2962	Enamel, Alkyd
CID A-A-2994	Primer Coating, Interior, For Wall and Wood
CID A-A-3127	Coating System: Aluminum Epoxy Mastic, For Minimally Prepared Atmospheric Steel
CID A-A-3132	Coating System: Epoxy Primer/Polyurethane Topcoat, For Minimally Prepared Atmospheric Steel
CID A-A-50542	(Rev A) Coating System: Reflective, Slip-Resistant, Chemical-Resistant Urethane for Maintenance Facility Floors
CID A-A-50574	Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

FEDERAL SPECIFICATIONS (FS)

FS TT-P-38	(Rev E) Paint, Aluminum (Ready-Mixed)

GRETAGMACBETH (GM)

GM-40291	(Matte Edition) Munsell Book of Color: Matte Finish Collection

MILITARY SPECIFICATIONS (MS)

MS MIL-P-24441/GEN	(Rev B; Am 1, Supple 1) Paint, Epoxy-Polyamide (Inch-Pound)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996; Errata 96-4) National Electrical Code

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub No. 84-100	(1984; Supple 1985, 1987, 1988, & 1990) NIOSH Manual of Analytical Methods

SSPC: THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 6	(1995) Containing Debris Generated During Paint Removal Operations
SSPC Paint 16	(1991) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - 'Inorganic' and Type II - 'Organic')
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC Paint 27	(1991) Basic Zinc Chromate-Vinyl Butyral Wash Primer
SSPC Paint 33	(1994) Coal Tar Mastic, Cold-Applied
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 5	(1994) White Metal Blast Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

1.2 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.3 WORK PERFORMANCE

Work shall be performed in accordance with the requirements of 29 CFR 1910, 29 CFR 1926, EM 385-1-1, and other references as listed herein. Matters of interpretation of the standards shall be submitted to the Contracting Officer for resolution before starting work. Where the regulations conflict, the most stringent requirements shall apply.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-08 Statements

Accident Prevention Plan; GA.

The requirements included in Section 01 of EM 385-1-1 shall be followed by the Contractor when preparing the Accident Prevention Plan. The plan shall be prepared for all sites and shall include, but is not limited to, each of the topic areas listed in Table 1-1 therein and the requirements of paragraph SAFETY AND HEALTH PROVISIONS; each topic shall be developed in a concise manner to include management and operational aspects. The plan must be prepared by a certified Industrial Hygienist

Waste Classification, Handling, and Disposal Plan; GA.

The Contractor is responsible for assuring the proper disposal of all hazardous and nonhazardous waste generated during the project. Therefore, the contractor shall develop a Waste Classification, Handling, and Disposal Plan for all job sites in accordance with the requirements of 40 CFR 261 and 40 CFR 262. In addition, the following provisions shall be included:

a. In the case of waste generated from abrasive blasting lead-containing paints with recyclable steel or iron abrasives, the spent abrasive shall be disposed of as a hazardous waste or shall be stabilized with proprietary blast additives regardless of the results of 40 CFR 261, App II, Mtd 1311. Where stabilization is preferred, the contractor shall employ a proprietary blast additive during blasting operations.

b. Hazardous waste shall be placed in closed containers and shall be shielded adequately to prevent dispersion of the waste by wind or water. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken.

c. Nonhazardous waste shall be stored in closed containers separate from hazardous waste storage areas.

d. All hazardous waste shall be transported by a licensed transporter in accordance with 40 CFR 263 and 49 CFR 171, Subchapter C.

e. All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation.

f. In addition to the number of manifest copies required by 40 CFR 262.22, one copy of each manifest will be supplied to the Contracting Officer prior to transportation.

Visible Emissions; GA.

For all jobs requiring tight control on emissions where lead is not present, the Contractor shall develop a plan monitoring the visible emissions from the project. The time of emissions shall be measured in accordance with 40 CFR 60, App A, Mtd 22. The plan shall also include the provisions for halting work and correcting the containment in the event unacceptable emissions are observed. General statements shall not be used; specific methods, procedures, and details are required. Random emissions from the containment shall not exceed 1 percent of the work day. The Contractor shall document each time that the work is halted due to a violation of the visible emissions criteria. Documentation shall include the cause for shutdown and the corrective action taken to resolve the problem.

SD-14 Samples

Special Paint Formulas; GA-RE.

Samples of special paint formulas, listed in paragraph PAINT FORMULATIONS, shall be submitted. For all vinyl-type paints submitted for laboratory testing, separate 1/2-pint samples of ingredient raw materials shall be furnished. The ingredient samples shall be clearly identified by commercial name, trade designation, manufacturer, batch or lot number, and such other data as may be required. For all epoxy type paints submitted for laboratory testing, a list of ingredient raw materials identifying commercial name, trade designation, manufacturer, batch or lot number, and such other data as may be required shall be furnished.

Specification and Proprietary Paints; GA-RE.

Federal, Military, Commercial Item Description, and SSPC: The Society for Protective Coatings specification paints are those formulated to meet federal, military, government and industry specifications. When the required quantity of any type is 50 gallons or less, the Contractor can submit:

a. A certified test report showing the results of required tests made on the material and a statement that it meets all of the specification requirements.

b. A certified test report showing the results of required tests made on a previous batch of paint produced by the same firm using the same ingredients and formulation except for minor differences necessitated by a color change and a statement that the previous batch met all of the specification requirements. A report of tests on the proposed batch showing the following properties applicable to the material specifications shall be furnished: color, gloss, drying time, opacity, viscosity, weight per gallon, and fineness of grind.

c. A proprietary paint - When the required quantity of a particular

type or color of a paint is 10 gallons or less, a proprietary, name-brand, shelf item paint of the same type and with similar properties to the material specified may be proposed without sampling. Proprietary paints are any which do not follow the formulas in paragraph, "PAINT FORMULATIONS" or the complete specification requirements of the government or industry specifications. To receive consideration, a statement from the supplier that the paint is appropriate as to type, color, and gloss and is a premium grade of paint shall be furnished.

Thinners; GA-RE.

Samples shall be submitted of the thinners which are those solvents used to reduce the viscosity of the paint.

SD-18 Records
Inspections and Operations; GA.

The Contractor shall document and submit records of inspections and operations performed. Submittals shall be made on a daily basis and shall include but are not limited to:

a. Inspections performed, including the area of the structure involved and the results of the inspection.

b. Surface preparation operations performed, including the area of the structure involved, the mode of preparation, the kinds of solvent, abrasive, or power tools employed, and whether contract requirements were met.

c. Thinning operations performed, including thinners used, batch numbers, and thinner/paint volume ratios.

d. Application operations performed, including the area of the structure involved, mode of application employed, ambient temperature, substrate temperature, dew point, relative humidity, type of paint with batch numbers, elapsed time between surface preparation and application, elapsed time for recoat, condition of underlying coat, number of coats applied, and if specified, measured dry film thickness or spreading rate of each new coating.

1.5 SAMPLING AND TESTING

The Contractor shall allow at least 30 days for sampling and testing. Sampling may be at the jobsite or source of supply. The Contractor shall notify the Contracting Officer when the paint is available for sampling. Sampling of each batch shall be witnessed by the Contracting Officer unless otherwise specified or directed. A 1-quart sample of paint and thinner shall be submitted for each batch proposed for use. The sample shall be labeled to indicate formula or specification number and nomenclature, batch number, batch quantity, color, date made, and applicable project contract number. Testing will be performed by the Government. Costs for retesting rejected material will be deducted from payments to the Contractor at the rate of $1500.00 dollars for each sample retested.

1.6 SAFETY AND HEALTH PROVISIONS

Paragraph SAFETY AND HEALTH PROVISIONS supplements the requirements of EM 385-1-1, paragraph (1). In any conflict between Section 01 of EM 385-1-1 and this paragraph, the provisions herein shall govern.

1.7 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the painting is incidental.

PART 2 PRODUCTS

2.1 SPECIAL PAINT FORMULAS

Special paints shall have the composition as indicated in the formulas listed herein. Where so specified, certain components of a paint formulation shall be packaged in separate containers for mixing on the job. If not specified or otherwise prescribed, the color shall be that naturally obtained from the required pigmentation.

2.2 PAINT FORMULATIONS

Special paint formulas shall comply with the following:

2.2.1 Formula E-303d, Epoxy Zinc-Rich Paint

INGREDIENTS	PERCENT BY WEIGHT	POUNDS	GALLONS
COMPONENT A			
Epoxy Resin, Type 1	35.9	277.8	28.1
Methyl n-Amyl Ketone	44.2	342.5	50.3
Toluene	6.0	46.3	6.9
Butanol	6.0	46.3	6.9
Suspending Agent M	6.5	50.0	6.9
Phthalocyanine Blue Pigment	1.4	11.0	0.9
	100.0	773.9	100.0
COMPONENT B			
Polyamide Resin	38.1	277.8	34.3
Isopropanol	12.7	92.6	14.2
Toluene	12.7	92.6	12.3
Butanol	35.4	257.6	38.2
Catalyst	1.1	8.1	1.0
	100.0	728.7	100.0
COMPONENT C			
Zinc Dust Pigment	100.0	5,000.0	85.0

a. Components A, B, and C of Formula E-303d shall be packaged separately as kits (unitized packaging permissible). The standard size kit shall be 2.85 gallons (mixed paint volume) consisting of 1 gallon of Component A, 1 gallon of Component B, and 50 pounds of zinc dust (Component C), packaged in a 2-gallon pail. Kits of larger or smaller sizes will be permitted, provided that the quantity relationship of the components shall be the same as the standard kit.

b. In addition to standard labeling requirements, each container of each component shall be properly identified as to component type and each container label of Component A shall carry the following: "MIXING INSTRUCTIONS: To prepare this paint for application, combine Components A and B and, while the mixture is being vigorously stirred with a heavy-duty power stirrer, sift in the zinc dust (Component C). Continue the stirring until the zinc dust has been well dispersed and the mixture is smooth. The mixed paint shall at some point be strained through a 30- to 60-mesh screen to prevent any undispersed zinc dust slugs from reaching the spray gun nozzle. Thin with an appropriate thinner where necessary to obtain satisfactory application results. The pot life of the mixed material, extended from time to time by the addition of small amounts of thinner, will normally be in excess of 24 hours but may be less in very warm weather. Stir the material continuously after mixing and during application."

2.2.2 Formula C-200a, Coal Tar-Epoxy (Black) Paint

The paint shall conform to SSPC Paint 16 manufactured with Type 1 pitch. In addition to standard labeling, container labels shall include the term, "Corps of Engineers Formula C-200a."

2.3 INGREDIENTS FOR SPECIAL PAINT FORMULAS

The following ingredient materials and thinners apply only to those special paints whose formulas are shown above in detail.

2.3.1 Pigments and Suspending Agents

2.3.1.1 Zinc Dust

Zinc dust pigment shall conform to ASTM D 520, Type II.

2.3.1.2 Phthalocyanine Blue

Phthalocyanine blue pigment for epoxy zinc-rich paint shall have properties similar and equal to Peacock Blue 249-1282 manufactured by Sun Chemical Co.

2.3.1.3 Suspending Agent M

Suspending Agent M shall be of soft translucent paste consisting of a thixotropic agent dispersed in toluene. It shall have a nonvolatile content of approximately 25 percent and a specific gravity of approximately 0.872. It shall be capable of minimizing the tendency of zinc dust to settle hard without increasing the viscosity of the paint significantly. MPA-60 (toluene), produced by Rheox, Inc., has these properties.

2.3.2 Resins, Plasticizer, and Catalyst

2.3.2.1 Catalyst

The catalyst for Formula E-303d shall be 2, 4, 6 tri(dimethylamino methyl) phenol. DMP-30, Rohm & Haas Co., is such a chemical.

2.3.2.2 Epoxy Resin, Type I

The epoxy resin for Formula E-303d shall be of the solid type conforming to ASTM D 1763 for a Type I, Grade 1, Class D resin except that it shall have

weight per epoxy equivalent (WPE) of 425-550 and the softening point shall be between 65 and 75.

2.3.2.3 Polyamide Resin

The polyamide resin for Formula E-303d shall be a condensation product of a dimerized fatty acid and polyamines. It shall be a solid resin at room temperature and have the following characteristics:

	MINIMUM	MAXIMUM
Amine value	85	95
Color (Gardner)	----	12
Specific Gravity, 25/25 degree C	0.97	0.99
Viscosity, Poises, 150 degrees C (Brookfield)	7	9

2.3.3 Solvent and Thinners

2.3.3.1 Isopropanol

Isopropyl alcohol shall conform to ASTM D 770.

2.3.3.2 Butanol

Butanol (butyl alcohol) shall conform to ASTM D 304.

2.3.3.3 Methyl n-Amyl Ketone

Methyl n-amyl ketone (MAK) shall conform to ASTM D 4360.

2.3.3.4 Toluene

Toluene shall conform to ASTM D 841.

2.4 TESTING

2.4.1 Chromatographic Analysis

Solvents in vinyl and epoxy paints and thinners shall be subject to analysis by programmed temperature gas chromatographic methods and/or spectrophotometric methods, employing the same techniques that give reproducible results on prepared control samples known to meet the specifications. If the solvent being analyzed is of the type consisting primarily of a single chemical compound or a mixture or two or more such solvents, interpretation of the test results shall take cognizance of the degree of purity of the individual solvents as commercially produced for the paint industry.

PART 3 EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

3.1.1 General Requirements

Surfaces to be painted shall be cleaned before applying paint or surface treatments. Deposits of grease or oil shall be removed in accordance with SSPC SP 1, prior to mechanical cleaning. Solvent cleaning shall be accomplished with mineral spirits or other low toxicity solvents having a

flashpoint above 100 degrees F. Clean cloths and clean fluids shall be used to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Items not to be prepared or coated shall be protected from damage by the surface preparation methods. Machinery shall be protected against entry of blast abrasive and dust into working parts. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces, and surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum; paint damaged by welding operations shall be restored to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed shall be painted before they become inaccessible.

3.1.2 All Ferrous Surfaces are Subject to Severe Exposure

Ferrous surfaces subject to extended periods of immersion or as otherwise required shall be dry blast-cleaned to SSPC SP 5. The blast profile, unless otherwise specified, shall be 1.5 to 2.5 mils as measured by ASTM D 4417, Method C. Appropriate abrasive blast media shall be used to produce the desired surface profile and to give an angular anchor tooth pattern. If recycled blast media is used, an appropriate particle size distribution shall be maintained so that the specified profile is consistently obtained. Steel shot or other abrasives that do not produce an angular profile shall not be used. Weld spatter not dislodged by blasting shall be removed with impact or grinding tools and the areas reblasted prior to painting. Surfaces shall be dry at the time of blasting. Blast cleaning to SSPC SP 5 shall be done in the field and, unless otherwise specifically authorized, after final erection. Within 8 hours after cleaning, prior to the deposition of any detectable moisture, contaminants, or corrosion, all ferrous surfaces blast cleaned to SSPC SP 5 shall be cleaned of dust and abrasive particles by brush, vacuum cleaner, and/or blown down with clean, dry, compressed air, and given the first coat of paint. Upon written request by the Contractor, the Contracting Officer may authorize mill or shop cleaning of assembled or partially assembled components specified to receive one of the vinyl-type paint systems or Systems Nos. 6-A-Z, 21-A-Z, and 21-B-Z employing the epoxy zinc-rich primer. The surfaces, if shop blasted, shall be shop coated with the first and second coats of the specified paint system except that the epoxy zinc-rich primed surfaces shall receive an extra single spray coat of the zinc primer at the time field painting is started, as specified in the paint system instructions. The shop coating shall be maintained in good condition by cleaning and touching up of areas damaged during the construction period. If pinpoint or general rusting appears, surfaces shall be reblasted and repainted at no added cost to the Government. Prior to the field application of subsequent coats, soiled areas of the shop coating shall be thoroughly cleaned and all welds or other unpainted or damaged areas shall be cleaned and coated in a manner to make them equivalent to adjacent, undamaged paint surfaces.

3.1.3 Galvanized, Aluminum, Aluminum Alloy, or Copper Surfaces

Where surfaces are specified to be painted, they shall be first washed with clean mineral spirits and then pretreated with a primer conforming to SSPC Paint 27 in accordance with the following instructions. The pretreatment primer shall be mixed by adding one volume of acid component (diluent) to four volumes of resin component (base solution) slowly and with constant stirring. After mixing, the material shall be used within 8 hours. The

pretreatment primer shall be spray applied at a coverage rate of 250 to 300 square feet per gallon (of resin component) to give a dry film thickness of 0.3 to 0.5 mil. Small areas may be coated by brush or swab. Care shall be exercised in spray application to avoid the deposition of dry particles on the surface. A wet spray shall be maintained at all times by additional thinning with Normal Butanol ASTM D 304. The acid component (diluent), over and above the amount prescribed above, shall not be used for thinning purposes. Surfaces shall receive the first coat of paint after at least 1 but not more than 24 hours drying of the pretreatment primer film.

3.1.4 Concrete Surfaces

New concrete surfaces, including concrete floors, shall be permitted to age for a minimum of 30 days prior to painting. Grease and oil removal shall be accomplished by solvent cleaning and/or detergent washing followed by rinsing. Loosely adherent materials such as dirt, dust, laitance, efflorescence, bleed water residues, or other foreign substances shall be removed by wire or fiber brushing, scrapers, light sandblasting, or other approved means. For interior walls and floors, sandblasting, unless otherwise specifically authorized, shall be restricted to the wet or vacuum type. Surface glaze, if present, shall be removed by light blasting or by scrubbing with a 5-percent solution of phosphoric acid. The texture of the surface after etching shall be roughly equivalent to the texture of an 80-120 grit sandpaper. If acid etching is used, the surface shall be thoroughly rinsed with clean water to remove all traces of the acid. Prior to painting, the concrete shall be dry. Adequate dryness shall be determined visually at the time of application by performing the following test. Tape 2-foot by 2-foot squares of polyethylene to the surface at random locations. The test patches shall remain in place overnight. Coatings may be applied if there are no traces of moisture and surfaces are dry beneath the polyethylene the following day.

3.2 PAINT APPLICATION

3.2.1 General

The finished coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture, and gloss. Application of initial or subsequent coatings shall not commence until the Contracting Officer has verified that atmospheric conditions and the surfaces to be coated are satisfactory. Each paint coat shall be applied in a manner that will produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint. Spray equipment shall be equipped with traps and separators and where appropriate, mechanical agitators, pressure gauges, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. Airless-type equipment shall not be used for the application of vinyl paints.

3.2.2 Mixing and Thinning

Paints shall be thoroughly mixed, strained where necessary, and kept at a uniform composition and consistency during application. Paste or

dry-powder pigments specified to be added at the time of use shall, with the aid of powered stirrers, be incorporated into the vehicle or base paint in a manner that will produce a smooth, homogeneous mixture free of lumps and dry particles. Where necessary to suit conditions of the surface temperature, weather, and method of application, the paint may be thinned immediately prior to use. Thinning shall generally be limited to the addition of not more than 1 pint per gallon of the proper thinner; this general limitation shall not apply when more specific thinning instructions are provided. Paint that has been stored at low temperature, shall be brought up to at least 70 degrees F before being mixed and thinned, and its temperature in the spray tank or other working container shall not fall below 60 degrees F during the application. Paint that has deteriorated in any manner to a degree that it cannot be restored to essentially its original condition by customary field-mixing methods shall not be used and shall be removed from the project site. Paint and thinner that is more than 1 year old shall be resampled and resubmitted for testing to determine its suitability for application.

3.2.3 Atmospheric and Surface Conditions

Paint shall be applied only to surfaces that are above the dew point temperature and that are completely free of moisture as determined by sight and touch. Paint shall not be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, the temperature of the surfaces to be painted and of air in contact therewith shall be not less than 45 degrees F during paint application nor shall paint be applied if the surfaces can be expected to drop to 32 degrees F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and applying artificial heat, provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint shall not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

3.2.4 Time Between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface.

3.2.5 Method of Paint Application

Unless otherwise specified, paint shall be applied by brush or spray to ferrous and nonferrous metal surfaces. Special attention shall be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces shall be subject to the specific approval of the Contracting Officer. Paint on plaster, concrete, or other nonmetallic surfaces shall be applied by brush, roller, and/or spray.

3.2.6 Coverage and Film Thickness

Film thickness or spreading rates shall be as specified hereinafter. Where no spreading rate is specified, the paint shall be applied at a rate normal for the type of material being used. In any event, the combined coats of a specified paint system shall completely hide base surface and the finish coats shall completely hide undercoats of dissimilar color.

3.2.6.1 Measurement on Ferrous Metal

Where dry film thickness requirements are specified for coatings on ferrous surfaces, measurements shall be made with one of the thickness gages listed below. They shall be calibrated and used in accordance with ASTM D 1186. They shall be calibrated using plastic shims with metal practically identical in composition and surface preparation to that being coated, and of substantially the same thickness (except that for measurements on metal thicker than 1/4 inch, the instrument may be calibrated on metal with a minimum thickness of 1/4 inch). Frequency of measurements shall be as recommended for field measurements by ASTM D 1186 and reported as the mean for each spot determination. The instruments shall be calibrated or calibration verified prior to, during, and after each use. Authorized thickness gages:

a. Mikrotest, Elektro-Physik, Inc.
b. Inspector Gage, Elcometer Instruments, Ltd.
c. Positest, Defelsko Corporation
d. Minitector, Elcometer Instruments, Ltd.
e. Positector 2000, Defelsko Corporation

3.2.6.2 Measurements on Nonferrous Metal

Where dry film thickness requirements are specified for coatings applied to nonferrous metal surfaces, measurements shall be made with one of the thickness gages listed. They shall be calibrated and used in accordance with ASTM D 1400. Calibration shall be on metal identical in composition and surface preparation to that being coated and of substantially the same thickness (except that for measurements on metal thicker than 1/4 inch, the instrument may be calibrated on metal with a minimum thickness of 1/4 inch). Frequency of measurements shall be as recommended for field measurements by ASTM D 1400 and reported as the mean for each spot determination. The instruments shall be calibrated or calibration verified prior to, during, and after each use. Authorized thickness gages:

a. Positector 3000 (aluminum and copper only)

b. Defelsko Corporation Minitector Model 250N, 150N, or 150FN, Elcometer Instruments, Ltd.

3.2.7 Progress of Painting Work

Where field painting on any type of surface has commenced, the complete painting operation, including priming and finishing coats, on that portion of the work shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating, and this period shall be modified as necessary to suit adverse weather conditions. Paint shall be considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces shall be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease, overspray, or foreign matter by means of airblast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, shall be brush-off blast cleaned and completely repainted

as required. Undercoats of high gloss shall, if necessary for establishment of good adhesion, be scuff sanded, solvent wiped, or otherwise treated prior to application of a succeeding coat. Field coats on metal shall be applied after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.8 Contacting Surfaces

When riveted or ordinary bolted contact is to exist between surfaces of ferrous or other metal parts of substantially similar chemical composition, such surfaces will not be required to be painted, but any resulting crevices shall subsequently be filled or sealed with paint. Contacting metal surfaces formed by high-strength bolts in friction-type connections shall not be painted. Where a nonmetal surface is to be in riveted or bolted contact with a metal surface, the contacting surfaces of the metal shall be cleaned and given three coats of the specified primer. Unless otherwise specified, corrosion-resisting metal surfaces, including cladding therewith, shall not be painted.

3.2.9 Drying Time Prior to Immersion

Minimum drying periods after final coat prior to immersion shall be: epoxy systems at least 5 days, vinyl-type paint systems at least 3 days, and cold-applied coal tar systems at least 7 days. Minimum drying periods shall be increased twofold if the drying temperature is below 65 degrees F and/or if the immersion exposure involves considerable abrasion.

3.2.10 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures shall be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. All metalwork coated in the shop or field prior to final erection shall be stored out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets; soiling, contamination, and deterioration of the paint film, and damaged areas of paint on such metalwork shall be cleaned and touched up without delay. The first field coat of paint shall be applied within a reasonable period of time after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.2.11 Coal Tar-Epoxy (Black) Paint (Formula C-200a)

3.2.11.1 Mixing

Component B shall be added to previously stirred Component A and thoroughly mixed together with a heavy-duty mechanical stirrer just prior to use. The use of not more than 1 pint of xylene thinner per gallon of paint will be permitted to improve application properties and extend pot life. The pot life of the mixed paint, extended by permissible thinning, may vary from 2 hours in very warm weather to 5 or more hours in cool weather. Pot life in warm weather may be extended by precooling the components prior to mixing; cooling the mixed material; and/or by slow, continuous stirring during the application period. The mixed material shall be applied before unreasonable increases in viscosity take place.

3.2.11.2 Application

Spray guns shall be of the conventional type equipped with a fluid tip of approximately 0.09 inch in diameter and external atomization, seven-hole air cap. Material shall be supplied to the spray gun from a bottom withdrawal pot or by means of a fluid pump; hose shall be 1/2 inch in diameter. Atomization air pressure shall not be less than 80 psi. High-pressure airless spray equipment may be used only on broad, simply configured surfaces. Brush application shall be with a stiff-bristled tool heavily laden with material and wielded in a manner to spread the coating smoothly and quickly without excessive brushing. The coverage rate of the material is approximately 110 square feet per gallon per coat to obtain 20 mils (dry thickness) in a two-coat system. The paint shall flow together and provide a coherent, pinhole-free film. The direction of the spray passes (or finish strokes if brushed) of the second coat shall be at right angles to those of the first where practicable.

3.2.11.3 Subsequent Coats

Except at the high temperatures discussed later in this paragraph, the drying time between coal tar-epoxy coats shall not be more than 72 hours, and application of a subsequent coat as soon as the undercoat is reasonably firm is strongly encouraged. Where the temperature for substrate or coating surfaces during application or curing exceeds or can be expected to exceed 125 degrees F as the result of direct exposure to sunlight, the surfaces shall be shaded by overhead cover or the interval between coats shall be reduced as may be found necessary to avoid poor intercoat adhesion. Here, poor intercoat adhesion is defined as the inability of two or more dried coats of coal tar-epoxy paint to resist delamination when tested aggressively with a sharp knife. Under the most extreme conditions involving high ambient temperatures and sun-exposed surfaces, the drying time between coats shall not exceed 10 hours, and the reduction of this interval to a few hours or less is strongly encouraged. Where the curing time of a coal tar-epoxy undercoat exceeds 72 hours of curing at normal temperatures, 10 hours at extreme conditions, or where the undercoat develops a heavy blush, it shall be given one of the following treatments before the subsequent coat is applied:

a. Etch the coating surface lightly by brush-off blasting, using fine sand, low air pressure, and a nozzle-to-surface distance of approximately 3 feet.

b. Remove the blush and/or soften the surface of the coating by wiping it with cloths dampened with 1-methyl-2-pyrrolidone. The solvents may be applied to the surface by fog spraying followed by wiping, but any puddles of solvent must be mopped up immediately after they form. The subsequent coat shall be applied in not less than 15 minutes or more than 3 hours after the solvent treatment.

3.2.11.4 Ambient Temperature

Coal tar-epoxy paint shall not be applied when the receiving surface or the ambient air is below 50 degrees F nor unless it can be reasonably anticipated that the average ambient temperature will be 50 degrees F or higher for the 5-day period subsequent to the application of any coat.

3.2.11.5 Safety

In addition to the safety provisions in paragraph, "SAFETY AND HEALTH PROVISIONS," other workmen as well as painters shall avoid inhaling

atomized particles of coal tar-epoxy paint and contact of the paint with the skin.

3.2.12 Epoxy Zinc-Rich Paint (Formula E-303d)

3.2.12.1 Mixing

Primer shall be field mixed combining components A, B, and C. The pot life of the mixed material may be extended by the addition of small amounts of thinner; normal pot life will be in excess of 24 hours but may be less in warm weather. Mixing shall be in accordance with label instructions.

3.2.12.2 Thinning

When the ambient and/or steel temperatures are below about 80 degrees F, this paint will not normally require over 15 percent thinning; but in any event, the paint shall at all times contain sufficient volatiles (thinners) to permit it to be satisfactorily atomized to provide a wet spray and avoid deposition of particles that are semidry when they reach the surface. Where thinning is required, either methyl ethyl ketone (MEK) or Alc-50 shall be used, with the latter preferred for general use.

3.2.12.3 Application

Conventional type (air atomization) spray equipment consisting of a paint pot with an agitator, 3/8-inch material hose, and a spray gun with an air cap, tip, and needle suitable for spraying lacquers and vinyl-type paints is preferred for applying this paint; however, airless equipment may be approved for use provided that application results are satisfactory. The paint shall be stirred continuously during application at a rate that will prevent the zinc dust from settling. When spraying is resumed after any interruption of longer than 15 minutes, the entire length of material hose shall be whipped vigorously until any settled zinc is redispersed. The hose shall be emptied whenever the painting operation is to be suspended for more than 1 hour. Paint shall be spray applied, except that areas inaccessible to spraying shall be brushed. The paint shall not be applied when the temperature of the ambient air and the receiving surfaces is less than 50 degrees F. It shall be applied in not less than two single spray coats with no limitations as to the minimum drying time between coats, provided that recoating does not cause running and sagging. The second coat shall be applied within 8 days, and the spray passes of the second coat shall be at right angles to those of the first coat where practicable.

Each coat of paint shall consist of a preliminary pass on edges, corners, interior angles, seams, crevices, junctions of joining member, rivets, weld lines, pits and similar surface irregularities, followed by an overall pass at a spreading rate of 350 square feet per gallon (based upon unthinned paint). Pits, cracks, and crevices shall be filled with paint insofar as practicable, but in any event, all pits surfaces shall be thoroughly covered and all cracks and crevices shall be sealed against the entrance of moisture. Rivets, bolts, and similar surface projections shall receive sprayed paint from every direction to ensure complete coverage of all faces.

3.3 PAINT SYSTEMS APPLICATION

The required paint systems and the surfaces to which they shall be applied are shown in this paragraph, and/or in the drawings. Supplementary information follows.

3.3.1 Fabricated and Assembled Items (FOR ITEMS NOT LISTED ON PAINTING SCHEDULES)

Items that have been fabricated and/or assembled into essentially their final form and that are customarily cleaned and painted in accordance with the manufacturer's standard practice will be exempted from equivalent surface preparation and painting requirements described herein, provided that:

a. Surfaces primed (only) in accordance with such standard practices are compatible with specified field-applied finish coats.

b. Surfaces that have been primed and finish painted in accordance with the manufacturer's standard practice are of acceptable color and are capable of being satisfactorily touched up in the field.

c. Items expressly designated herein to be cleaned and painted in a specified manner are not coated in accordance with the manufacturer's standard practice if different from that specified herein.

3.3.2 Surface Preparation

The method of surface preparation and pretreatment shown in the tabulation of paint systems is for identification purposes only. Cleaning and pretreatment of surfaces prior to painting shall be accomplished in accordance with detailed requirements previously described.

3.3.3 System No. 2

The first coat shall be brush or spray applied in the shop or field as indicated at a maximum spreading rate of 500 square feet per gallon and touched up in the field as necessary to maintain its integrity at all times. The second or third coats of the system shall be applied in the field at a maximum spreading rate of 450 square feet per gallon. Prior to applying field coats, all field welds, other bare metal, and damaged areas of the shop-primed surfaces shall be cleaned and primed as previously specified except that application shall be by brush.

3.3.4 System No. 6-A-Z

Epoxy zinc-rich primer shall be applied with a minimum of two single, half-lapped spray coats to an average minimum dry film thickness of 3.0 mils, and the thickness at any point shall not be less than 2.5 mils for the primer. After a minimum drying period of 6 hours and no more than 96 hours for the second zinc-rich coat, at least two coats of coal tar epoxy paint shall be applied to provide a minimum thickness at any point of 16 mils for the completed system. If the second coat of epoxy zinc-rich paint has been applied in the shop or otherwise has been permitted to cure for longer than 96 hours, it shall be recoated with an additional thin tack coat of the zinc-rich paint, which in turn shall be overcoated within 96 hours with the first coat of coal tar-epoxy paint. The specified film thicknesses shall be attained in any event, and any additional coats needed to attain specified thickness shall be applied at no additional cost to the Government.

3.4 PAINTING SCHEDULES

3.4.1 L385-Final Plan for painting/galvanizing

The following painting schedule order shall be used over all painting requirements for System No 2 and 6-A-2.

1. Sluice gates, stem support brackets, and operators will be painted as per Corps L385 Spec, Section 09965. Stainless steel and bronze will not be painted.

2. Stoplog posts and supports, recesses for posts, embedded steel and misc. steel associated with stoplog closures will be galvanized after fabrication. The stoplogs are aluminum and do not require galvanizing or painting.

3. Rolling Gates and exposed embedded steel associated with the rolling gate closures will be painted with aluminum paint per Corps L385 Spec, Section 09965.

4. Cast iron flap gates and cast iron grates and manhole covers will not be painted.

5. Ladders, fabricated grates, support for grates, fabricated hatches, rungs (except those which are PSI-B manhole step from MA industries), handrail, grab bars and associated parts will be galvanized after fabrication. Any stainless steel or bronze parts will not be galvanized.

3.4.1.1 **Surfaces Not to be Painted.**

Paint shall not be applied to aluminum, rubber, corrosion-resisting steel, non-ferrous, finished or machined surfaces or to galvanized parts. Metal surfaces to be embedded in concrete shall not be painted.

SYSTEM NO. 2

Items or surfaces to be coated: Ferrous Metals which are non-Submerged Items

Ferrous Metals: Rolling Gates, Posts for Stoplogs, misc. metals (except as otherwise noted)

SURFACE PREPARATION	1st COAT	2nd COAT	3rd COAT
Power tool or brush-off blast cleaning	SSPC Paint 25 Type I	FS TT-P-38 (Aluminum)	FS TT-P-38 (Aluminum)

SYSTEM NO. 6-A-Z

Items or surfaces to be coated: Submerged Items

Sluice Gates: Submerged Items (i.e., frame, disc, etc.)

SURFACE PREPARATION	1st & 2nd COAT	3rd COAT
White metal blast cleaning	Epoxy zinc-rich paint E-303d (3 mils DFT)	Coal tar epoxy C-200a (black) (8 mils DFT)

3.4.2 Unpainted and painted items not listed above.

All stainless steel or galvanized items are not to be painted unless inbeded in concrete, specified or approved by the COR. All other items shall be painted. If a there is a conflict the COR will specify the correct application to be applied.

-- End of Section --

PHASE II

DIVISION 10 – SPECIALTIES

NOT APPLICABLE

PHASE II

DIVISION 11 – EQUIPMENT

11289 Closure Gates and Closure Stoplogs

SECTION 11289

CLOSURE GATES AND CLOSURE STOPLOGS
04/93

PART 1 GENERAL

See rolling gate and stoplog drawing details for clarifications.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB 16	(1996) Standard Specifications for Highway Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1	(1992) Carbon Steel Tee Rails
ASTM A 27/A 27M	(1995) Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 148/A 148M	(1993b) Steel Castings, High-Strength, for Structural Purposes
ASTM A 240/A 240M	(1996) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 276	(1996) Stainless Steel Bars and Shapes
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A 320/A 320M	(1994a; R 1995) Alloy Steel Bolting Materials for Low-Temperature Service
ASTM A 325	(1996) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 564/A 564M	(1995) Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A 504	A504-93(1999) Standard Specification for Wrought Carbon Steel Wheels
ASTM A 570/A 570M	(1995) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M	(1994c) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 668/A 668M	(1996) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 722/A 722M	(1990) Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM A 730	(1999) Forgings, Carbon and Alloy steel for Railway Use
ASTM B 6	(1995a) Zinc
ASTM B 22	(1995) Bronze Castings for Bridges and Turntables
ASTM B 30	Copper-Based Alloys in Ingot Form
ASTM B 103	Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar
ASTM B 148	(1993a) Aluminum-Bronze Sand Castings
ASTM B 248	Wrought Copper and Copper-Alloy Plate, Sheet, Strip and Rolled Bar
ASTM B 255	(1983a; R 1990) Sintered Bronze Structural Parts
ASTM B 271	Copper-Based Alloy Centrifugal Castings
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 413	(1982; R 1993) Rubber Property - Adhesion

	to Flexible Substrate
ASTM D 471	(1996) Rubber Property - Effect of Liquids
ASTM D 572	(1988; R 1994) Rubber - Deterioration by Heat and Oxygen
ASTM D 2240	(1995) Rubber Property - Durometer Hardness

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1996) Structural Welding Code - Steel
AWS D1.2	(1990) Structural Welding Code - Aluminum
AWS D1.2A	(1983) Commentary on Structural Welding Code - Aluminum

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1922	(Rev A) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 1) Shield, Expansion (Shelf Drilling Tubular Expansion Shell Bolt Anchors)
CID A-A-1925	(Rev A; Notice 1) Shield, Expansion (Nail Anchors)
CID A-A-1928	(Basic) Padlock (Combination)
CID A-A-55614	(Rev A) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Rev A) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)
CID A-A-60005	(Rev E; Notice 1) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

FEDERAL SPECIFICATIONS (FS)

FS RR-C-271	(Rev D) Chains and Attachments, Welded and Weldless
FS RR-W-410	(Rev D; Am 1) Wire Rope and Strand

1.2 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Sequencing and Scheduling; GA-RE.

Sequencing and scheduling plan shall be submitted and approved before the work is commenced.

manufactured units; GA-RE.
Fabrications; GA-RE.

Data

SD-04 Drawings

Detail Drawings; GA-RE.

Detail drawings shall be submitted as specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-07 Schedules

Materials; FIO-RE.

Materials orders, materials lists and materials shipping bills shall be submitted as specified in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-08 Statements

Welding; GA-RE.

Schedules of welding procedures for structural steel and other metals shall be submitted as specified in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-09 Reports

Tests, Inspections, and Verifications; FIO-RE.

Certified test reports for material tests shall be submitted with all materials delivered to the site.

SD-18 Records

Materials Disposition; FIO-RE.

System of identification which shows the disposition of specific lots of approved materials and fabricated items in the work shall be submitted before completion of the contract.

1.4 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.5 DELIVERY, STORAGE, AND HANDLING

Delivery, handling, and storage of materials and fabricated items shall conform to the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.5.1 Rubber Seals

Rubber seals shall be stored in a place which permits free circulation of air, maintains a temperature of 70 degrees F or less, and prevents the rubber from being exposed to the direct rays of the sun. Rubber seals shall be kept free of oils, grease, and other materials which would deteriorate the rubber. Rubber seals shall not be distorted during handling.

1.6 SEQUENCING AND SCHEDULING

A sequencing and scheduling plan which illustrates that work affecting railroads and roadways has been coordinated with Contracting Officer Representative, shall be developed. The plan shall include schedules, lists of labor or materials to be provided the affected company, and any other aspects of the work that may impact on the operations of these entities as specified in Section, SPECIAL SCHEDULING. The protection plan shall clearly demonstrate how all railroad tracks public or private roads, streets, or highways will be kept open to traffic at all times during the construction period, except as otherwise specified or directed. Refer to Section, SPECIAL SCHEDULING for other requirements such as warning signs, flagmen, permits, and debris removal.

PART 2 PRODUCTS

2.1 MATERIALS

Materials orders, materials lists and materials shipping bills shall conform with the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.1.1 Metals

Structural steel, steel forgings, steel castings, stainless steel, bronze, and other metal materials used for fabrication shall conform to the requirements shown and specified herein and in Section, MISCELLANEOUS METALWORK.

2.1.1.1 Structural Steel

Structural steel plates and shapes except angles shall conform to ASTM A 572/A 572M. Structural steel bars and angles shall conform to ASTM A 36/A 36M.

2.1.1.1 Self-Lubricating Bronze Bushings

Self-lubricating bearings shall conform to ASTM B 255, Type II. The bearings shall be impregnated with a turbine grade lubricant containing oxidation and rust inhibitors and a polar anti-wear additive.

2.1.1.2 BUSHINGS (All gates)

Material for bushings shall be per ASTM B 271, C86200, centrifugally cast, high strength manganese bronze. Raw material for remelting and casting shall be in ingot form per ASTM B 30. Contractor shall furnish material certification for each heat of material used for bushings. See drawing for dimensions, tolerances and finish for bushings.

2.1.1.3 Bronze Castings

Bronze castings shall conform to ASTM B 22, Copper Alloy UNS No. C91300 or and ASTM B 148.

2.1.1.4 Stainless Steel Bars and Shapes

Stainless steel bars and shapes shall conform to ASTM A 276, UNS S 30400, Condition A, hot-finished or cold-finished, Class C; or ASTM A 564/A 564M, UNS S 45000, Condition A, age-hardened heat treatment, hot-finished or cold-finished, Class C.

2.1.1.5 Stainless Steel Plate, Sheet, and Strip

Stainless steel plate, sheet, and strip shall conform to ASTM A 240/A 240M, UNS S 30400,. Plate finish shall be hot-rolled, annealed or heat-treated, and blast-cleaned or pickled. Sheet and strip finish shall be No. 1.

2.2 MANUFACTURED UNITS

Bolts, nuts, washers, screws and other manufactured units shall conform with the requirements shown and specified herein and in Section, MISCELLANEOUS METALWORK.

2.2.1 Bolts, Nuts and Washers

High-strength bolts, nuts, and washers shall conform to ASTM A 325, Type one, hot-dip galvanized or ASTM A 490, Type one. The finished shank of bolts shall be long enough to provide full bearing. Washers for use with bolts shall conform to the requirements specified in the applicable specification for bolts.

2.2.2 Screws

Screws shall be of the type indicated.

2.2.3 Winch

Winch shall be a 10 ton (2000lb./ton) all steel, spur gear, industrial barge winch. Drum and ring gear shall be cast steel. Winch shall have spring loaded holding dog with release handle, shall be capable of free spooling, and shall have a minimum of 2 speeds to enable fast cable take up. Operation shall be with a fully adjustable crank handle with pinion or a 28" min. dia. handwheel; whichever best suits winch house as detailed on contract drawings. Winch shall be equipped with wire rope as specified below. Winch shall be similar or equal to that as manufactured by "Wintech International" Model R10

(crank) or R10W (wheel). http://www.wintec-winches.com/ ph.888-946-8325

2.2.4 Sheaves

Sheaves shall be of cast steel conforming to ASTM A 27/A 27M, sized for the wire rope used and/or as detailed on drawings.

2.2.5 Rails

See Section 05055, paragraph titled "Rail".

2.2.6 Wire Rope (For all rolling gates

The rope shall be 3/4" dia., multi-purpose, flexible (for manual reeving on pulleys), and shall be configured 6x31 IWRC (Independent Wire Rope Core). Material shall be galvanized premium steel. Breaking strength shall be a minimum of 25 ton.

2.2.6 Wheel Truck Assemblies

2.2.6.1 Wheel Axles

The wheel axles shall be fabricated from forged steel conforming to ASTM A 730, Grade I with a minimum yield strength of 55,000 psi, and shall be machine finished as detailed on the drawings.

2.2.6.2 ADDITIONAL AXLE REQUIREMENTS(All gates)

Each axle shall be machined from a homogeneous piece of steel. Welding of 2 or more pieces of material to form a piece large enough for machining WILL NOT BE ALLOWED. See drawing for dimensions, tolerances and finish for machining of axle. Special attention shall be given to the machining of the grease groove (width, depth, length, helix and profile). THE TRANSITION AREA AT THE O. D. OF THE AXLE AND THE 1/32" RADIUS (EACH SIDE OF GREASE GROOVE) SHALL BE BLENDED (PROBABLY BY HAND) TO ENSURE A SMOOTH CONTOUR INTO AND OUT OF THE GREASE GROOVE. All axles shall be given a protective coating of grease or oil to eliminate formation of corrosion during shipping and storage. Prior to assembly, the protective coating shall be thoroughly cleaned from all surfaces of the axle and new clean 90 weight oil applied for assembly.

2.2.6.3 Wheels

The wheels shall be fabricated from wrought carbon steel conforming to ASTM A 504, Class C with a hardness range of 321 to 363 HB. Wheels shall be double-flanged and shall be machine finished as detailed on the drawings.

2.2.6.4 Grease Fittings and Grease

Shall be similar or equal to those as detailed and described on drawings.

(All gates)Grease fittings for axles shall be Alemite Corporation part number 1627-B (General Motors No. 273349) or approved equal. Fitting is 1/4", tapered pipe thread, SAE extra short. Contractor shall coordinate boring and tapping of threads for hole in axle for grease fitting.

Grease for lubricating the wheels shall be a number 2 lithium base complex. A suitable alternate and pre-approved equivalent is a number 2 calcium base complex.

2.2.6.5 Shims

Shims used for wheel alignment shall be fabricated from corrosion resistant sheet stock of either brass, bronze, or stainless steel. Number and thickness of the shims will be the responsibility of the contractor, and as determined for alignment of wheel trucks. Shims shall be fabricated according to detail shown on drawings. All edges shall be deburred and shall be cut straight and perpendicular to each other. If disassembled for shipping shims shall be matchmarked with wheel trucks and gate position.

2.2.6.6 Wheel Bearings

The wheel bearings shall be similar or equal to those as detailed and described on drawings.

2.2.6.7 Miscellaneous Wheel Components

Wheel truck bracket, hub caps, seal retainers, and axle retainers shall be machined from structural steel as specified here within unless otherwise approved. Machining shall be as detailed on drawings unless otherwise approved.

2.2.7 Axle Seals

Axle seals shall be similar or equal to those as specified in drawings.

2.2.8 THRUST WASHERS (SPACER DISCS)(All gates)

Material for thrust washers shall be per ASTM B 103, C54400, phosphor bronze, temper H04 and ASTM B 248 (as applicable). Contractor shall furnish material certification for each heat of material used for thrust washers. See drawing for dimensions, tolerances and finish for washers.

2.2.9 Padlocks and Hasps

Padlocks shall conform to CID A-A-1928, Type I. Padlocks shall be keyed alike and provided with two keys. Hasps shall be of wrought steel and sized to accommodate padlocks.

2.3 Stoplog Closures

2.3.4 Miscellaneous Metals and Standard Articles

2.3.1 Structural Steel

ASTM A 36, or ASTM A 572, Grade 50, as indicated. Galvanized after fabrication.

2.3.2 Steel Tubing

ASTM A 500, Grade B , welded, outside dimensions and nominal wall thickness as shown. Galvanized after fabrication.

2.3.3 Steel Pipe and Pipe Fittings

ASTM A 53, Type E, Grade B, electric-resistance welded, galvanized, nominal size and weight class or outside diameter and nominal wall thickness as shown with plain ends.

2.3.4 Bars and Shapes

Stainless steel bars and shapes shall conform to the following as specified or shown:

a. ASTM A 276, UNS S30400, Condition A, hot-finished or cold-finished, Class C.

b. ASTM A 564, UNS S17400 or S45000, age-hardened heat treatment condition, hot-finished or cold-finished, Class C.

2.3.5 Threaded Rod Steel Rods

Threaded Rod Steel Rod ASTM A 449, galvanized after fabrication.

Stainless Steel Rod ASTM A 276, Strain hardened, type 316 with minimum yield strength of 75 ksi and minimum ultimate strength of 95 ksi.

2.3.6 Bolts, Nuts, and Washers

Bolts, nuts, and washers shall be of the material, grade, type, class, style and finish indicated or best suited for intended use. High-Strength Bolts, Nuts, and Washers Bolts: ASTM A 325, Type 1, hot-dip galvanized.

Nuts: ASTM A 563, hot-dip galvanized. Bolts, Nuts, and Washers (Other than High-Strength)

a. Bolts and Nuts - ASTM A 307, Grade A, hot-dip galvanized.
b. Bolts - ASME B18.2.1.
c. Nuts - ASME B18.2.2.
d. Washers

(1) Plain Washers - ASME B18.22M ASME B18.22.1, Type B.
(2) Lock Washer - ASME B18.21.1.
(3) Beveled Washers - ASTM F 436, Beveled.

2.3.7 Screws

Screws shall be of the material, grade, type, style, and finish indicated or best suited for use intended. Cap Screw ASME B18.2.1,ASME B18.3, or ASME B18.6.2 as required. Machine Screws ASME B18.6.3.

2.3.8 Welded Shear Studs

ASTM A-108, minimum yield strength of 50 ksi, minimum ultimate strength of 55 ksi.

2.3.9 Welding Electrodes

AWS D1.1, E70 Series or as required by AWS Specification.

2.3.10 Aluminum Alloy 6061-T6

a. ASTM B 221 and ASTM B 429 for bars, rods, wires, pipes and tubes. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

2.3.11 Embedded Anchor Bolts, Expansion Anchor Bolts.

Material: ASTM F 593 Stainless steel, Type 304 or 316. Provide Type 316 unless noted otherwise. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as indicated on Drawings whichever is larger. Depth of embedment: minimum embedment as recommended by manufacturer or nine diameters of bolt, whichever is larger. Notify Contracting Officer if required depth of embedment cannot be achieved at a particular anchor bolt location. Follow manufacturer's recommendations for installation and torque.

Expansion anchor bolts shall be as specified in Section, MISCELLANEOUS METALWORK.

Submit manufacturer's load test data to verify at least one of each bolt diameter size. The anchor bolt capacities at the following embedment depths: (Data must be based on actual tests performed in unreinforced mass concrete of not more than 4000 psi compressive strength. Capacity must be at a concrete temperature of at least 130 Degrees F).

ANCHOR BOLT EMBEDMENT & CAPACITY

ANCHOR BOLT DIAMETER	MINIMUM MINIMUM EMBEDMENT (IN)	ULTIMATE TENSION CAPACITY (KIP)
1/2	4-1/2	8.1
5/8	5-5/8	11.4
3/4	6-3/4	15.4
7/8	7-7/8	20.1
1	9	24.1
1-1/4	11-1/4	34.3

2.3.12 Galvanizing Repair Paint

High zinc dust content paint for regalvanizing welds and abrasions. Dried film shall contain not less than 83 percent zinc dust by weight.

2.3.13 Cast Iron Castings

Cast iron castings for stoplog attachment covers adn frames shall be as specified for manhole frame adn cover in SECTION, STORM-DRAINAGE SYSTEM.

2.3.14 Rubber Seal Pad and Adhesive for Stoplogs

Rubber seal material shall be fabricated from material having the same characteristics and material properties as one of the following products. The adhesive used to bond the material to the stoplog shall be as recommended by the manufacturer and as submitted and approved.

1) Compound PO-655 as manufactured by Custom Urethane Elastomers, Inc.
2) Product 75a as manufactured by Seals Unlimited Inc.
3) Keelshield (smooth surface) as manufactured by Wendt Productions Inc.

2.3.15 J-Type Rubber Seals

See Specifications Section 03150, paragraph titled "Rubber J-Seals".

2.3.16 Manufactured Units

2.3.16.1 DELETED

2.3.16.2 Stoplogs

Stoplogs shall be fabricated from aluminum tubes to the dimensions indicated on the drawings. Rubber seals shall be bonded to the stoplogs as indicated on the drawings with an adhesive recommended by the manufacturer of the seal material, and as approved, and suited to the use intended. The pades shall also be attached with screws to the stoplogs as indicated on the drawings.

2.3.16.3 Stoplog Tie Down Straps

Two-piece, 2" wide polyester webbed straps with flat hook on each end. Rachet buckle for tightening. Minimum working load shall be 1000 lb. Minimum length of 20 feet.

2.4 FABRICATION

2.4.1 Detail Drawings

Detail drawings of closure gates and appurtenant items, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.4.1.1 Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.4.1.2 Shop Assembly Drawings

Shop assembly drawings shall provide details for connecting the adjoining fabricated components in the shop to assure satisfactory field installation.

2.4.1.3 Delivery Drawings

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent distortion or other damages.

2.4.1.4 Field Installation Drawings

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment.

2.4.2 Structural Fabrication

Structural fabrication shall conform with the requirements shown and specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Components shall be shop-fabricated of the materials specified and shown. Dimensional tolerances shall be as specified and shown. Splices shall occur only where shown. Pin holes shall be bored in components after welding, straightening, stress-relieving, and threading operations are completed. Brackets, eye bar sections, and other components requiring straightening shall be

straightened by methods which will not damage the material. Bronze bushings shall be press-fitted with supporting components. Bolt connections, lugs, clips, or other pick-up assembly devices shall be provided for components as shown and required for proper assembly and installation.

2.4.3 Welding

Welding shall conform with the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Welds shall be in accordance with AWS D1.1 and AWS D1.2 of the type shown and approved detail drawings. Radiographic examination is required on the major shop and field welds of the type and location indicated and as follows: none required. Welds which have been designated to receive radiographic examination and are found to be inaccessible to a radiation source or film, or are otherwise so situated that radiographic examination is not feasible may be examined, with written approval, by dye penetrant, magnetic particle tests, or ultrasonic tests.

2.4.4 Bolted Connections

Bolted connections shall conform with the requirements specified in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.4.5 Machine Work

Machine work shall conform with the requirements specified in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.4.6 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform with the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.4.7 Fabrications

Fabrications shall conform to the following requirements.

2.4.7.1 Wheel Fabrication

Wheels shall be machine finished as detailed on drawings. Machining shall be done using the highest fit and finish manufacturing standards for a product of this type.

2.4.7.2 DELETED

2.4.7.3 Wall Quoin

Wall quoin shall consist of a welded structural steel frame with adjustable base anchors and adjustable quoin contact block.

2.4.7.4 Quoin and Miter Contact Blocks

Quoin and miter contact blocks shall be of stainless steel bars conforming to ASTM A 276 or ASTM A 564/A 564M. Splices in the contact block shall be made by an offset method so that there will not be a continuous joint across the block. Contact faces of the contact block shall be milled at splices to assure watertight joints. Splices in the gate leaf contact

block shall occur only at the centerlines of horizontal girders. Contact blocks shall be provided with adjusting bolts as shown.

2.4.7.5 Seal Assembly

Seal assembly shall consist of rubber seals, steel retainer and deflection bars, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Steel retainer bars shall be field-spliced only where shown and machine-finished after splicing.

2.4.7.6 Miscellaneous Embedded Metals

Wall armor, shear anchors, protection and seal plates and shapes, and other miscellaneous embedded metals shall be of structural steel or corrosion-resisting steel conforming with the details specified herein and shown.

2.4.8 Shop Assembly

Shop assembly requirements for gates and appurtenant items shall be as shown and specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Gates and appurtenant items shall be assembled completely in the shop, unless otherwise approved, to assure satisfactory field installation. Adjoining components shall be fitted and bolted together to facilitate field connections. The matchmarking of unassembled items shall be carefully preserved until the items are assembled. Mating surfaces and machined surfaces shall be covered with a rust preventive until assembly. Assembled components shall be shop-welded in their final positions as much as delivery and field installation conditions will permit. Rubber seals shall be fitted and drilled to match the seal retainers, match-marked, and removed for shipment,or they shall be left mounted and shall be well protected from damage by wood staving firmly mounted to the gate. Wheel bearings shall be prepacked with lubricant prior to assembly with axle and wheel. After axles, bearings, seals, and wheel are assembled the axles shall be mounted to the wheel truck bracket. The assemblies shall then be greased to the extent that the grease exits the grease relief fitting. The completed assembly shall then be cleaned and degreased and either painted in assembly with the gate or painted as a separate assembly and then installed on the gate. In either case the bracket to gate mating surface shall be painted prior to assembly to gate. The wheel truck assemblies shall be mounted to the gate and aligned as detailed on the drawings. The wheels and shims shall then be either match marked and removed for shipping or at the discretion of the contractor may be left on for shipment. Shop assembly and disassembly work shall be performed in the presence of the Contracting Officer unless waived in writing. The presence of the Contracting Officer will not relieve the Contractor of any responsibility under this contract.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

Tests, inspections, and verifications for materials shall conform to the

requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, AND MISCELLANEOUS PROVISIONS.

2.6 Rolling Gate

Shop Assembly: The bottom truss of each gate, including truss chords, diagonals, wheel support channels (MC12s) and wheel assemblies shall be shop assembled, aligned and match marked in the shop before shipping.

Tolerances: Rail and wheel alignment tolerances shall meet the requirements specified in the contract drawings.

2.7 Railroad Track Bearing Pads

Bearing pads for the railroad track shall be urethane durometer 90 or harder, plain elastomeric bearing in accordance with the current AREA Manual for Railway Engineering.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform with the requirements specified herein and in Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. Gates and appurtenant items shall be assembled for installation in strict accordance with the contract drawings, approved installation drawings, and shop match-markings. Before assembly and installation, all bearing surfaces requiring lubrication shall be thoroughly cleaned and lubricated with an approved lubricant. All components to be field-welded shall be in correct alignment before welding is commenced.

3.1.1 Embedded Metals

Corner protection angles, sill angles, seal plates, frames, pedestals, bases and other embedded metal items required for proper and complete installation shall be accurately installed to the alignment and grade required to ensure accurate fitting and matching of components. Embedded metals shall be given a primer coat of the required paint on all surfaces prior to installation in concrete forms. Anchors for embedded metals shall be installed as shown. Items requiring two concrete pours for installation shall be attached to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour. Welded field splices in sealing surfaces of embedded items shall be ground smooth.

3.1.2 DELETED

3.1.3 Painting

Exposed parts of gates and appurtenances except machined surfaces, corrosion-resistant surfaces, surfaces of anchorages embedded in concrete, and other specified surfaces shall be painted as specified in Section, PAINTING: HYDRAULIC STRUCTURES.

3.1.4 Seal Assemblies

Rubber seal assemblies shall be installed after the embedded metal components have been concreted in place and the gate installation, including painting, completed. Rubber seals shall be adjusted and fastened

securely to metal retainers. Before operating the gate the embedded sealing surfaces shall be cleaned of all foreign substances and, a vegetable oil or mineral based lubricant shall be applied to the rubber seal rubbing plates to protect the rubber. Do not use a petroleum based lubricant.

3.2 PROTECTION OF FINISHED WORK

Protection of finished work shall conform to the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.3 ACCEPTANCE TRIAL OPERATION

After completion of the gate installation, the Contracting Officer will examine the gates for final acceptance. The gates will be examined first to determine whether or not the workmanship conforms to the specification requirements. The Contractor will then be required to operate the gates from the fully-opened to the fully-closed position a sufficient number of times to demonstrate that all parts are functioning properly. The workmanship in the fabrication and installation of gates shall be such that the gates in the closed position will form a watertight barrier across the opening. Required repairs or replacements to correct defects, shall be made at no additional cost to the Government. The trial operation shall be repeated after defects are corrected. Prior to final acceptance of the gates, the Contractor shall provide temporary restraints to prevent unauthorized operation of the gates.

3.3.1 TRIAL OPERATION AND TEST

With the rolling gate complete and rails secured in position, the gate shall be moved from the parked (open) position to the closed position and back again by means of the supplied winch system. In the closed position, the upper binders and the lower tie rods shall be installed. In the parked (open) position, the storage tiedowns shall be installed. This cycle shall be performed at least two times to demonstrate, to the satisfaction of the COR, compliance with the specification requirements and acceptable operation.

In the closed position, with the neoprene bearing pads in contact with the abutments, the minimum acceptable clearance between the inside face of the river side wheel flange and the side of rail head shall be 1/4-inch.

Before opening the gate, a suitable lubricant shall be applied to the rubber seal rubbing plates to protect the rubber seal. In the closed position, the COR will visually inspect the position of the seals for unacceptable fit. There shall be no gaps between the seal and the sealing surface.

3.3.2 PLACEMENT IN STORAGE

Upon completion of the gate installation and just prior to placing the gate in storage; only portions of the rubber seals exposed to sunlight shall be degreased and shall be given a brush coat of common black exterior latex house paint to protect them from UV radiation. Paint shall be applied neatly and shall not be splattered over other gate or concrete surfaces. The gates shall be rolled to the storage position and the tiedowns shall be

installed and locked.

-- End of Section --

PHASE II

DIVISION 12 – FURNISHINGS

NOT APPLICABLE

PHASE II

DIVISION 13 – SPECIAL CONSTRUCTION

NOT APPLICABLE

PHASE II

DIVISION 14 – CONVEYING SYSTEMS

NOT APPLICABLE

PHASE II

DIVISION 15 – MECHANICAL

15161	Submersible Pump, Axial-Flow and Mixed-Flow Type
15200	Discharge Pipe and Appurtenances
15301	Sluice Gates – Miscellaneous Drainage Structures
15302	Sluice Gates and Hoist – Pump Station

SECTION 15161

SUBMERSIBLE PUMP, AXIAL-FLOW AND MIXED-FLOW TYPE
01/00

PART 1 GENERAL

SCOPE

The work provided for herein consists of furnishing all plant, labor, materials and equipment and designing, manufacturing, factory testing, delivering, storing, installing and field testing the stormwater pumps with discharge tube complete with all necessary accessories and appurtenances, all as shown on the contract drawings and specified herein. The pumps shall be designed, constructed, assembled and tested according to the provisions of the Hydraulic Institute Standards except as noted herein.

1.1 QUALITY CONTROL.

The Contractor shall establish and maintain quality control for all stormwater pump operations to assure compliance with contract requirements and maintain records of quality control for all construction operations, including but not limited to the following:

(1) Machine work and electrical work.

(2) Shop painting.

(3) Use of specified materials and equipment.

(4) Shop assembly

(5) Factory performance and cavitation tests.

(6) Preparation for shipment and storage.

(7) Inspection at the worksite for damage to and defects in all material and equipment.

(8) Storage at the worksite.

(9) Installation and all field tests.

(10) Operation and maintenance after installation.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.3.1 Acoustical Society of America (ASA).

ASA S2.19-89	Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance (ASA 86)

American Society of Mechanical Engineers (ASME).

ASME B 4.1-67 (R 1994)	Preferred Limits and Fits for Cylindrical Parts
ASME B46.1-95	Surface Texture (Surface Roughness, Waviness, and Lay)
ASME BPV Code Section IX	Boiler and Pressure Vessel Code(Addenda Dec 95) Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S2.19	(1989) Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance (ASA 86)

American Society for Testing and Materials (ASTM).

ASTM A 27/A 27M-95	Steel Castings, Carbon, for General Application
ASTM A 36/A 36M-96	Carbon Structural Steel
ASTM A 48-94 (Rev. A)	Gray Iron Castings
ASTM A 108-95	Steel Bars, Carbon, Cold Finished, Standard Quality
ASTM A 167	Stainless Steel Plate , UNS S30400 or
ASTM A 176	Stainless Steel Plate , UNS S40500
ASTM A 242/A 242M	Steel Plate
ASTM A 276-96	Stainless Steel Bars and Shapes
ASME A 285	Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A 297/A 297M-93	Steel Casting, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for

	General Application
ASTM A 312/A 312M-95	Seamlesss and Welded Austenitic Stainless(Rev. A)Steel Pipes
ASTM A 488	Steel Castings, Welding, Qualifications of Procedures and Personnel
ASTM A 516/A 516M-90	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM 572	High-Strength Low-Alloy Columbium-Vanadium(Rev. C)Structural Steel
ASTM A 576-90	Steel Bars, Carbon, Hot-Wrought, Special (Rev. B)Quality
ASTM A 668/A 668M-96	Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM B 148/B 148M-93 (Rev. A)	Aluminum-Bronze Sand Castings
ASTM B 584-93 (Rev. B)	Copper Alloy Sand Castings for General Applications
ASTM D 2000-95	Rubber Products in Automotive Applications

American Welding Society (AWS).

AWS D1.1	Structural Welding Code Steel
AWS D11.2	Guide for Welding Iron Castings

American Water Works Association (AWWA).

AWWA C200-91	Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203-91	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
AWWA C207-94	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
AWWA C208-83	Dimensions for Fabricated Steel Water Pipe Fittings (Rev. 1989)

Hydraulic Institute (HI) - 1994 Edition.

HI 1.1-1.5	Centrifugal Pumps
HI 1.6	Centrifugal Pump Tests
HI 2.1-2.5	Vertical Pumps
HI 2.6	Vertical Pump Tests

HI 9.1-9.5	Pumps - General Guidelines

International Society for Measurement and Control (ISA).

ISA RP2.1	Manometer Tables

National Electrical Manufacturer's Association (NEMA).

NEMA MG 1-93 (Rev. 1995)	Motors and Generators
NEMA WC 7-88	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (R 1992)

1.3 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS.

1.3.1 General Project Requirements.

Design, furnish, and install submersible pumping units for the L-385 project pump station as described below. Water pumped will not exceed 80 degrees F, will be relatively turbid, and may contain sand, silt, and trash capable of passing the trashrack, having 3 inch clear openings. The pumps shall be of such design that no major modifications, alterations or additions, will be required to the pumping stations and/or suction bays to accommodate them. However, requests for changes in the setting of the pumps, discharge tubes and accessories, which would involve only minor modifications, will be considered. Any such modifications will be at the expense of the Contractor. The pumps shall be designed such that removal for routine maintenance can be accomplished by use of a mobile crane. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 50 ft.

1.3.1.1 Quindaro Pump Station.

Two identical vertical submersible propeller pumps shall be furnished. Two vertical pump discharge tubes shall be constructed to the dimensions shown on the contract drawings and furnished. The two pumps are to be installed in the gravity drain conduits as shown on the contract drawings. The pumps are for the purpose of pumping storm water from open drainage ditches into the Missouri River.

1.3.2 Pumping Unit Description.

In general, each pumping unit includes a pump/motor, discharge tube, discharge elbow, lifting chain or equivalent hoisting system, and control/power cables. Each pump shall be of the vertical, axial or mixed-flow submersible type for stormwater flood control attached to the same shaft of a submersible electric motor. The pump/motor shall be installed in a discharge tube. Except as otherwise stated or noted, the terms pump and pump/motor both refer to a pump/motor integral unit.

1.3.3 General Design Requirements.

(1) The pumps shall meet head, capacity, speed, efficiency, pump sump design, range of operation, cavitation, and vibration requirements as

specified. The Contractor may utilize fixed or adjustable propeller blades to meet the specification performance requirements.

(2) The pumps shall, as a minimum, meet the design, materials, and manufacture requirements of HI 1.1-1.5, HI 2.1-2.5, HI 9.1-9.5, ASA S2.19-89,ASME B 4.1-67 (R 1994),ASME B46.1-95,ISA RP2.1,ASME B46.1-95,ASTM 572,ASTM A 516/A 516M-90 and these specifications.

(3) The pumps shall operate in discharge tubes. The discharge tubes shall fit within the dimensions shown so that a mobile crane can carry out installation. The weight of the pump/motor integral unit and the discharge tube shall not exceed -

Quindaro Pump Station - 18,000 lb.

(4) The pumps shall be designed for the calculated hydraulic pressure including waterhammer to which the pump parts are exposed.

(5) The pump losses, as calculated by the Contractor, are in addition to the specified head and shall be allowed for when computing the pump system output. The hydraulic quantities are as defined in HI 1.1-1.5, HI 2.1-2.5, and HI 9.1-9.5.

(6) The pumps shall have a continuously rising head characteristic with decreasing capacity over the required range of operation specified. The pumps shall not have unstable operating characteristics over the required range of operation.

(7) The pumps shall meet all requirements for net positive suction head required (NPSHR) and operate without surging.

(8) Associated pumping equipment including, but not limited to, power and control cables shall be suitable for outdoor operation.

1.3.4 Discharge System.

Each pump shall discharge through a short piece of discharge pipe and a flap gate into a discharge chamber as shown on the contract drawings.

1.3.5 Operating Conditions.

The pump shall be capable of operating in the dry (for the purpose of maintenance and operating checks) for short periods of time as stated in the manufacturer's operating instruction.

1.3.6 Performance Requirements.

(1) The maximum level of vibration of the assembled pumping unit shall not be greater than that allowed in the Hydraulic Institute Standards, Centrifugal Pumps, Paragraph for vertical, non-clog pumps.

(2) The pump shall be capable of operating without instability over the required range of heads.

1.3.7 Capacities.

Each pump shall discharge a capacity not less than the capacity indicated

against total heads corresponding to static heads with sump elevations as shown in the tables following.

Quindaro Pump Station.

Pumping Conditions	Pumping Capacity Required GPM	TDH Feet	Sump Elevation NGVD
Low Head	20,000	6.0	744.0
Design Operating	15,700	25.0	740.0
High Head	12,000	28.3	736.0

1.3.8 Dynamic head.

The total dynamic head includes the design static heads plus all of the losses beyond the pump; from a point 20 inches above the top of the pump including all friction losses plus the velocity head.

1.3.9 The pump manufacturer.

The pump manufacturer in his submittal, shall include all pump losses to a point 20 inches above the top of the pump to determine the pump bowl head.

1.3.10 Efficiency.

The pump efficiency, as defined in Hydraulic Institute Standards for Vertical Pumps shall be not less than 70 percent at the Design Operating point specified and shall not be less than 45 percent at the Low Design Operating point specified.

1.4 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES.

SD-01 Data

Materials; GA-RE.

Submit a list designating materials to be used for each pump part along with the submittal of the drawings. If deviation from specified materials is desired, submit complete specifications for the proposed deviating materials after award of the contract.

Equipment Supplies and Performance; GA-RE.

Within 60 days of Notice of Award, submit the names of the manufacturers, performance capacities, and other relevant information for the machinery and other equipment contemplated to be incorporated into the work.

Spare Parts; FIO-RE.

Submit 10 copies of manufacturers complete parts list showing all parts, spare parts, and bulletins for pump. Clearly show all details, parts, and

adequately describe parts or have proper identification marks. The parts lists shall be printed on good quality 8 1/2 in. by 11 in. paper, bound separately of the Operation and maintenance manual with a flexible, durable cover. Drawings incorporated in the parts lists may be reduced to page size provided they are clear and legible, or they may be folded into the bound lists to page size. Photographs or catalog cuts of components may be included for identification.

Computations; GA-RE.

Submit sufficient hydraulic computations to substantiate pump selection and demonstrate that the selected pump can meet the project design and operating requirements as specified.

SD-04 Drawings

Submersible Pump; GA-RE.

Within 60 days of Notice of Award, submit drawings listed below. Submitted drawings shall be of sufficient size to be easily read. Submit information in the English language. Dimensions shall be in metric with English conversion.

a. Outline drawings of the pump showing dimensions and weight of the pump/motor.

b. Drawings showing details and dimensions of pump mounting design and layout including any embedded items.

c. Cross-sectional drawings of each pump, showing each component, should show major or complicated sections of each pump in detail. On each drawing indicate an itemized list of components showing type, grade, class of material used, and make and model of the standard component used. Include detail and assembly drawings of the entire pumping unit assembly for each pump.

d. Provide drawings covering the installation that the Contractor intends to furnish to the erecting engineer.

e. The capacity-head curve with design points indicated for each pump. The curves shall also indicate efficiency, kW, and NPSHR.

f. Motor characteristic curves or tabulated data (test or calculated) should indicate the speed, power factor, efficiency, current, and kilowatt input, all plotted or tabulated against percent load as abscissas for each motor.

g. Complete descriptive specification of the motors furnished, with necessary cuts, photographs, and drawings to clearly indicate the construction of the motors, the treatments used to prevent corrosion of parts, bearing construction, and type of insulation used on all windings.

h. Nameplate data for each motor.

i. Guaranteed value of motor power factor and efficiency for full load, 3/4 full load, and 1/2 full load.

SD-06 Instructions

Installation Instruction Manual; GA-RE.

No later than time of pump delivery, submit three copies of a typed and bound manual describing procedures to be followed by the installation engineer in assembling, installing, and dry- and/or wet-testing the pump. Coordinate and consolidate the description of the pump with similar descriptions for other specified pump parts. The description shall be of such a nature that it may be comprehended by an engineer or mechanic without extensive experience in erecting or installing pumps of this type. The description shall be a step-by-step explanation of operations required, and shall include, where applicable, such things as alignment procedures, bolt torque values, recommended instrument setups, recommended gauges and instruments, and similar details. The contracting Officer may request changes or modifications to the manuals deemed necessary or desirable.

SD-08 Statements

Factory Test; FIO-RE.

Submit a description of the factory test setup and test procedure proposed. Submit data and drawings sufficient to demonstrate that testing is in compliance with HI 2.6 and this specification.

Field Test; GA-RE.

Submit the field test plan prior to field testing.

Materials; GA-RE.

If deviation from specified materials is desired, submit complete specifications for the proposed deviating materials after award of the contract.

Pump Erection Engineer Resume; GA-RE.

Submit a resume for each erection engineer to be used a minimum of 30 days prior to installation of the pump tubes.

Casting Acceptance Criteria; GA-RE.

The manufacturers criterion for acceptance (established quality control standards) of castings and casting repairs including the approved welding procedure for each material used shall be submitted to the Contracting Officer within 60 days of date of Notice To Proceed. Standards which are not definitive or which delegate discretionary authority for the acceptability of castings or casting repairs to a manufacturers representative or other individual are not acceptable.

Test Set-Up Plan; GA-RE.

Submit a description of the test set-up and test procedures proposed for the performance and cavitation tests within 120 days of date of Notice to Proceed. The submittal shall include the information required. Submit data and drawings sufficient to demonstrate that testing is in compliance with HI 1.6, HI 2.6 and HI 9.1-9.5.

Quality Assurance Field Test Plans; GA-RE.

Submit the field test plans a minimum of seven (7) days prior to the quality assurance field tests.

Installation List; GA-RE.

Submit the list of installations where pumps of this type have been provided by the pump manufacturer as specified in paragraph of section.

SD-09 Reports

Factory Test; GA-RE.

Within 30 days of acceptable witnessed factory tests, submit six (6) bound copies of the factory test reports for each pump. The factory test reports shall include the information required.

Field Test; GA-RE.

Submit five (5) copies of the field test report.

Motor Tests; FIO-RE.

Within 30 days of the specified tests on each motor, submit six (6) bound copies of the motor test reports. The motor test reports shall include the information required in this specification Section.

Installation Report; FIO-RE.

Submit the installation report as required by paragraph, "Pump Erection Engineer."

SD-19 Operation and Maintenance Manuals

Operating and Maintenance Instruction; GA-RE.

Submit eight copies of the manual containing complete information on operation, lubrication, adjustment, routine and special maintenance disassembly, repair, reassembly, and trouble diagnostics of pump and auxiliary equipment. The operation and maintenance manual shall be printed on good quality 8 1/2 in. by 11 in. paper, bound separately from the parts list, and bound between a flexible, durable cover. Drawings incorporated in manual may be reduced to page size provided they are clear and legible, or they may be folded into the manual to page size. Photographs or catalog cuts of components may be included for identification.

1.5 PUMP SUPPLIER EXPERIENCE AND RESPONSIBILITY.

The pumps shall be designed and manufactured by a firm that is regularly engaged in the manufacture of the type of submersible pump described in these specifications. The pump manufacturer shall have overall responsibility to design and supply the pumping unit (submersible pump/motor, discharge tube, discharge elbow, cables, and accessories) that meet the requirements of this specification. The pump manufacturer shall supply a list of a minimum of 50 installations at which submersible pumps of its manufacture, similar in type to those specified and 100 Hp or greater, have been operating for at least 5 years in the United States.

1.6 SHIPPING AND STORAGE.

The pumps will be inspected for damage or other distress when received at the project site. The pumps and equipment shall have adequate short-term storage in a covered, dry, and ventilated location prior to installation. The manufacturer's instructions shall be followed for extended storage. Proper equipment for handling the pump shall be supplied and shall be considered as special tools if not completely standard.

1.7 SPECIAL TOOLS.

Furnish one set of all special tools required to completely assemble, disassemble, or maintain the pumps. Special tools refer to oversized or specially dimensioned tools, special attachment or fixtures, or any similar items. Lifting devices required for use in conjunction with a mobile crane shall be furnished.

1.8 PUMP ERECTION ENGINEER.

The Contractor shall furnish a competent erection engineer fluent in the English language who is knowledgeable and experienced with the installation and start-up procedures for submersible pumps and the associated equipment specified. The erection engineer shall be a full time employee of the pump manufacturer or shall be designated as an erection engineer, in writing, by the pump manufacturer. A resume shall be submitted for the erection engineer(s) to be used. The resume shall list years of experience in pump field service and a list of installations similar to this one where the erection engineer had been used. When so requested, the erection engineer shall be responsible for providing complete and correct direction during installation, initial starting, and subsequent operation of equipment until all field tests are successfully completed. The erection engineer shall initiate instructions for actions necessary for proper receipt, inspection, handling, uncrating, assembly, and testing of equipment. The erection engineer shall also keep a record of measurements taken during erection and shall furnish one copy to the Contracting Officer on request or on the completion of the installation of assembly or part. The erecting engineer shall instruct the Contracting Officer or others as designated in the operation and maintenance features of the pump units.

PART 2 PRODUCTS

2.1 MATERIALS AND METALWORK FABRICATION.

2.1.1 General.

Materials and fabrication shall conform to the requirements of Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS and Section, MISCELLANEOUS METALWORK and to additional specified requirements. Classifications and grade of material incorporated in the work shall be in accordance with designated specifications. Material selection shall be guided by HI 1.1-1.5, HI 2.1-2.5, and HI 9.1-9.5 for corrosion, erosion, and abrasion resistance. Deviations from the specified materials shall be submitted in accordance with the specificatons. The materials of construction shall comply with the following:

TABLE 1 - MATERIALS OF CONSTRUCTION

PART	MATERIAL
Propeller	Stainless steel or aluminum bronze

TABLE 1 - MATERIALS OF CONSTRUCTION

PART	MATERIAL
Shaft (if in contact with effluent)	Stainless Steel
Shaft (if not in contact with effluent)	Structural steel (high strength)
Wearing rings	Manufacturer's standard rings
Discharge bowl	Cast iron
Bearings	Manufacturer's standard bearings
Bolts, key, etc.	Stainless steel
Suction bell	Cast iron
Pump bowl	Cast iron
O-rings	Nitrile rubber
Mechanical seals	Tungsten carbide
Discharge tube (incl. cover)	Steel
Discharge elbow	Steel
Anchor bolts	Stainless Steel

2.1.2 Designated Materials

Designated materials shall conform to the following specifications, grades, and classifications.

MATERIALS	SPECIFICATION, GRADE, CLASS
Aluminum-Bronze	ASTM B 148/B 148M-93 (Rev. A), Alloy No. C95500 Castings
Cast Iron	ASTM A 48-94 (Rev. A), Class Nos. 30A, 30B, and 30C
Cast Steel	ASTM A 27/A 27M-95 Grade 65-35, annealed
Coal Tar Protective Coatings	AWWA C203-91
Cold-Rolled Steel Bars	ASTM A 108-95, min, Wt. Strm 65,000 psi
Copper Alloy Castings	ASTM B 584-93 (Rev. B), Alloy No. C93700
Corrosion-Resistant Alloy Castings	ASTM A 297/A 297M-93, Grade CA-15, CAGNN and CF-8M
Dimensions for Steel Water Pipe Fittings	AWWA C208-83
Hot-Rolled Stainless	ASTM A 576-90, Graded G10200, G10450, and G11410
Ring Flanges	AWWA C207-94, Class B
Rubber Products in Automotive Applications	ASTM D 2000-95
Seamless and Welded Austenitic Stainless Steel Pipe	ASTM A 312/A 312M-95
Stainless Bars and Shapes	ASTM A 276-96, Grades S30400 and S41000

MATERIALS	SPECIFICATION, GRADE, CLASS
Steel Forging	ASTM A 668/A 668M-96, Class F
Steel Pipe 6 in. and Larger	AWWA C200-91
Steel Plates, Pressure Vessel	ASTM A 516/A 516M-90, Grade 55
Steel Plate	ASTM A 242/A 242M
Stainless Steel Plate	ASTM A 167, UNS S30400 or ASTM A 176, UNS S40500
Quality Steel	ASTM A 36/A 36M-96
Surface Texture	ASME B46.1-95

2.1.3 Bolted Connections

2.1.3.1 Bolts, Nuts, and Washers

Bolts, nuts, and washers shall conform to requirements herein specified and the paragraphs, "SUBMERSIBLE PUMP" and "DISCHARGE TUBE AND DISCHARGE ELBOW," and the subparagraph, "NUTS AND BOLTS" for types required. Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to bolt axis.

2.1.3.2 Materials Not Specifically Described

Materials not specifically described shall conform to the latest ASTM specification or to other listed commercial specifications covering class or kinds of materials to be used.

2.1.4 Flame Cutting of Material.

Flame cutting of material other than steel shall be subject to the approval of the Contracting Officer. Shearing shall be accurately done, and all portions of work neatly finished. Steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a smooth surface free from cracks and notches is secured. Surfaces and edges to be welded shall be prepared in accordance with Section 3 of AWS D1.1. Chipping and/or grinding will not be required except where specified and as necessary to remove slag and sharp edges of technically guided or hand-guided cuts not exposed to view. Visible or exposed hand-guided cuts shall be chipped, ground, or machined to metal free of voids, discontinuities, and foreign materials.

2.1.5 Alignment of Wetted Surfaces.

Exercise care to ensure that the correct alignment of wetted surfaces being joined by a flanged joint is being obtained. Where plates of the water passage change thickness, a transition shall occur on the outer surface, leaving the inner surface properly aligned. When welding has been completed and welds have been cleaned, but prior to stress relieving, joining of plates shall be carefully checked for misalignment of adjoining parts.

2.1.6 Machine Work.

2.1.6.1 Fits.

All tolerances, allowances and gages for metal fits between plain, nonthreaded cylindrical parts shall conform to ASME B4.1, for the class of fit required.

2.1.6.2 Finishes.

Where surface finishes are indicated in the pump shop drawings or specified herein, the symbols used or finishes specified shall be in accordance with ASME B46.1. Values of roughness height specified are the arithmetical average deviation expressed in micro inches. Roughness specified is the maximum value and any lesser degree will be satisfactory unless otherwise called for on the drawings. Compliance with specified surface shall be determined by sense of feel and by visual inspection of the work compared to Roughness Comparisons Specimens, in accordance with the provisions of ANSI B46.1. Values of roughness width and waviness height are not specified, but shall be consistent with the general type of finish specified by roughness height. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for rejection.

2.1.6.3 Pin Holes.

Pin holes shall be bored true to gages, smooth and straight, and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

2.1.6.4 Shafting.

Unless otherwise specified or authorized, all shafting shall be turned or ground. Fillets shall be provided where changes in section occur.

2.1.7 Castings.

2.1.7.1 General.

Each casting shall have the mark number cast or stamped upon it. Castings not meeting the approved acceptance criteria shall be either rejected or repaired as dictated by the criteria. Repairs to castings shall not be made prior to approval by the Contracting Officer.

2.1.7.2 Repair of Castings.

Repairs shall be accomplished in accordance with the approved procedure and repaired areas shall be reinspected to ensure completed repairs are satisfactory. Castings shall have all unsound material or defects removed by chipping, machining, air-arc gouging or grinding and shall be repaired by welding. Welding repairs shall conform to the welding procedures, which shall have been developed and approved for the type material involved. Stress relief annealing, where required, shall be accomplished prior to final machining. All welding repair shall conform to the applicable portions of AWS D1.1, AWS D11.2, ASTM A 488, and the ASME BPV Code Section IX.

2.2 SUBMERSIBLE PUMP

2.2.1 Design and Manufacture.

The major components of the submersible pumps shall be of cast materials. The level of manufacture skill shall be consistent with the standards referenced in the specifications. All work performed in the manufacture of the pumps shall be performed in a skillful and workmanlike manner in accordance with the best modern shop practice and manufacture of finished products similar in nature to those specified herein. The Government reserves the right to observe and witness the manufacture of the pumps and to inspect the pumps for compliance with standard good practice during factory assembly.

2.2.2 Vibration.

Vibration limits shall be as specified in section performance requirements.

2.2.3 Speed.

2.2.3.1 Pump Speed Quindaro Pump Station.

Rotative speed of the pump shall not be greater than 900 rpm.

2.2.3.2 Runaway Speed.

The pumps shall be designed to sustain full runaway speed without damage at maximum head difference across the pumps. Based on the system design as shown by the drawings the manufacturer shall compute the maximum reverse runaway speed, and the pumps and motors shall be designed to sustain that reverse rotation without damage.

2.2.4 Pump Construction.

2.2.4.1 General.

The major pump components shall be of materials as described in Table 1. The components shall have smooth surfaces, devoid of blow holes, irregularities, and other manufacturing defects. All the exposed nuts and bolts shall be stainless steel. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. The fitting shall be such that the sealing is accomplished by metal-metal contact between machined surfaces which results in controlled compression of the O-rings. Sealing compounds, grease, or secondary devices are not acceptable. The pumps, with appurtenances and cables, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 15 meters. The pumps shall be designed, constructed and tested according to the applicable provisions of the Hydraulic Institute Standards. A rubber seal shall be provided between the pump and discharge tube to prevent leakage of pump discharge back into the suction chamber.

2.2.4.2 Pump Handling Provisions.

The pumps shall be designed such that removal for routine inspections or maintenance can be accomplished by use of a mobile crane for raising and lowering the pumps in and out of the discharge tubes. The pumps shall be furnished with a lifting handle to facilitate handling. The lifting handle shall be designed to bear the entire weight of the pumping unit at a conservative factor of safety. A means shall be provided to allow the pump to be removed from the pump tube in one operation without having to secure the pump and reconnect the hoist hook being used. The Contractor shall follow the manufacturers recommendations for handling of the pumps.

2.2.4.3 Pump and Motor Bearing Arrangement.

The pump and motor shaft shall rotate on a minimum of three (3) permanently lubricated bearings. The upper bearing shall be a roller bearing and the lower bearing shall consist of one double row angular contact ball bearing and one single row roller bearing. The bearing system shall be capable of handling all up and down vertical thrust loads plus any radial loads. The bearings shall be of the grease lubricated and sealed type. The bearings shall have a minimum B-10 bearing life of 50,000 hours. Each bearing shall be of the correct design to resist the radial and thrust loads applied. Enough bearings shall be provided to ensure the pump rotating elements are supported so that the possibility of excessive vibration is eliminated.

2.2.4.4 Mechanical Seals.

A mechanical rotating shaft seal system shall be provided between the propeller and motor to ensure the motor housing seal. The mechanical seals shall be in tandem, lapped and face type seals running in lubricant reservoirs for cooling and lubrication. The mechanical seals shall contain both stationary and rotating tungsten carbide face rings unless otherwise specified. In order to avoid seal failure from sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the lubricant housing. All seal faces must be solid material capable of being relapped. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

2.2.4.5 Propeller.

The propeller design and manufacture shall be the manufacturer's standard. The propeller surface shall be smooth, without holes and fabrication offsets. The propeller shall be of a multi-blade design with variable fixed blade pitches in a range of 9 - 21 degree angles. The propeller shall have blade angles available in 2 degree increments to optimize pump performance and efficiency. The propeller blade angle shall be factory set by the manufacturer to meet the design points specified. The propeller shall be capable of handling fibrous materials, silt and other matter found in storm water applications. The attachment to shaft shall be with keys or other fasteners, which are to be made of stainless steel. The attachment should be of sturdy construction designed to not loosen, but be easily removed for maintenance. The propeller shall be cast aluminum-bronze or cast stainless steel. At the time of assembly the propeller clearances shall be those shown on assembly drawings and may be checked in the field or at the factory at the Contracting Officer's option.

The propeller shall be balanced at the design operating speed. The standard balance quality grade is G 6.3 in accordance with ANSI S2.19. Weights needed to achieve the required balance shall be placed on a firm surface and shall be placed in water passage so that it does not impede water flow in any way.

2.2.4.6 Shaft.

The shaft shall be one piece, integral with the motor, of high-strength stainless steel or high-strength structural steel, with a factor of safety of five measured against the ultimate strength. The shaft shall be designed for all torque conditions during normal operation and for runaway

speed during reverse flow.

2.2.4.7 Bowl Assembly.

The bowl assembly shall be cast iron. The hydraulic design shall be the manufacturer's standard design as used in previous operating installations. An aluminum bronze or stainless steel wear ring shall be provided along the propeller swept area of the bowl.

a. Flanges.

Flanges shall be machined and bolt holes shall be drilled concentric with the pump shaft vertical centerline. Flanges shall be machined parallel and mounted parallel to a plane that is normal to the pump shaft centerline or discharge centerline. The mating surface on all flanges shall be finished machined to a 125 micro-inch finish or better. Flanges used to determine vertical concentricity shall have a rabbit fit or be fitted with dowel pins so that disassembly does not destroy pump shaft concentricity.

b. Mating Joints.

All pump internal mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber O-rings without requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

c. Nuts and Bolts.

All bolts used in assembling the pump and its supporting members including anchor bolts and dowels shall be of corrosion resisting or stainless steel and shall be of the hexagonal head type. All nuts shall be silicon bronze or stainless steel. Cap screws of stainless steel when used with silicon bronze or stainless steel nuts are permitted.

2.2.5 Motors.

The motors shall be submersible and conform to the requirements of NEMA MG 1-93. The motors shall be of sufficient size to avoid overload at any of the specified operating points. The motors shall be 3-phase, 60-Hz, 460 V, squirrel cage induction type, NEMA Design B Type. The stator windings and stator leads shall be insulated with a moisture-resistant Class F insulation with temperature resistance of 1550 C. The service factor shall be 1.1. The temperature rise above ambient for continuous full load rated conditions and for the class of insulation used shall not exceed the values in NEMA MG 1-93. The motors shall be rated for continuous duty when submerged and shall also be capable of operation in the dry for short periods of time for testing and maintenance purposes.

2.2.5.1 Torque.

Starting torque shall be sufficient to start the pump, but in no case less than 60 percent of full-load torque. Break-down torque shall not be less than 200 percent of full-load torque.

2.2.5.2 Locked-rotor Current.

The motors shall not have a Locked Rotor Indicating Code higher than F as shown in Table 430-7(b) of the National Electric Code.

2.2.5.3 Starting Capabilities.

The motors, on the basis of the load torque characteristics and the load Wk2 listed in MG 1-20.40 of NEMA MG 1-93 shall as a minimum be capable of making the starts required in MG 1-20.43 of NEMA MG 1-93.

2.2.5.4 Duty Cycle.

Each motor, when operating at rated voltage and frequency and on the basis of the connected pump Wk2 and the speed--torque characteristics of the load during starting conditions as furnished by the pump manufacturer, shall be capable of sustaining a minimum of ten (10) starts per hour without injurious temperature rise.

2.2.5.5 Balance.

The balance for each motor when measured in accordance with MG 1-12.06 or MG 1-20.53 of NEMA MG 1-93 shall not exceed the values specified in MG 1-12.05 or MG 1-20.52 of NEMA MG 1-93, respectively.

2.2.5.6 Corrosion Prevention and Finish Painting.

The equipment furnished under these specifications will be subjected to severe moisture conditions and shall be designed to render it resistant to corrosion from such exposure. The general requirements to be followed to mitigate corrosion are specified below. Any additional special treatment or requirement considered necessary for any individual items is specified under the respective item. However, other corrosion-resisting treatments that are the equivalent of those specified herein may, with the approval of the Contracting Officer, be used.

a. Fastenings and Fittings.

All screws, bolts, nuts, pins, studs, springs, washers and other similar fittings shall be of corrosion-resisting material.

b. Corrosion-Resisting Materials.

Corrosion-resisting steel, copper, brass, bronze, copper-nickel and nickel-copper alloys are acceptable corrosion-resisting materials.

c. Corrosion-Resisting Treatments.

When properly done and of a sufficiently heavy coat, hot-dip galvanizing; sherardizing; and zinc, cadmium and copper plating are approved corrosion-resisting treatments. Other corrosion-resisting treatments may be used if approved by the Contracting Officer.

d. Cores.

The assembled motor core shall be thoroughly cleaned and then immediately primed by applying a minimum of two coats of a moisture-resisting and oil-resisting insulating varnish or compound. Air gap surfaces shall be given a minimum of one coat.

2.2.6 Cable.

Power and instrumentation cables shall be specifically designed for use with a submersible pump application and shall conform to the requirements of NEMA WC 7-88. Submersible cables shall be suitable for continuous immersion in water at the maximum depth encountered. Cables shall have an ampacity of not less than 125 percent of the motor full load current. The pump manufacturer shall determine the cable lengths required for each installation. Except where cables are connected to the motor terminal wiring, cables shall contain no splices in the length from the junction boxes to the motors.

2.2.6.1 Cable Entry.

Power and instrumentation cables shall enter the motor through a sealing system that prevents water entry into the unit and provides strain relief. The cable entry may be comprised of rubber bushings, flanked by stainless steel washers, having a close tolerance fit against the cable outside diameter and the entry inside diameter for sealing by compression of the bushing, or the entry may be sealed by other gland compression methods.

2.2.7 Pump Control and Monitoring.

Sensors shall be provided to monitor critical elements of the pumping units. The sensors shall be monitored by the electrical monitoring and control equipment specified in Section, ELECTRIC WORK GENERAL. The sensors shall indicate when a pump component has an abnormal operating condition. As a minimum the following sensors shall be provided:

(1) The stator shall be equipped with three (3) thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase).

(2) Temperature sensor to monitor the lower thrust bearing.

(3) Float-switch sensor positioned to detect liquid leakage before it reaches the motor stator.

(4) A junction box leakage detector.

2.2.8 Dry Operation.

The pumping unit shall be constructed to allow completely dry operation as follows; two 2 minute operation periods separated by a twenty minute rest period during each one hour period with the unit starting temperature of 29.4 degrees C. and an air temperature of 29.4 degrees C. After a one hour rest period the pumping unit shall be able to repeat the above sequence.

2.3 DISCHARGE TUBES AND DISCHARGE ELBOWS.

2.3.1 General.

The design and fabrication of the discharge tubes and elbows shall be by

the pump manufacturer. The discharge tubes and elbows shall be installed according to the directions of the pump manufacturer. For purposes of performance and this specification it shall be treated as part of the pumping unit.

2.3.2 Discharge Tubes and Elbows.

The discharge tubes shall be of such size to accommodate the dimensions of the pump supplied in accordance with the manufacturer's requirements. They shall be fabricated from a minimum of 0.625-inch thick steel plate for the Quindaro Pump Station and a minimum of 0.5-inch thick steel plate for the Riverside Pump Station. The design shall be such that the pumps will be automatically and firmly connected to the discharge tube when lowered into place and shall be in accordance with the pump manufacturer's instructions. A locking device or o-ring shall be provided that prohibits rotational movement of the pumping unit within the tube. The pumps shall be easily removable for inspection or service without need to enter the pump sump. The pumps shall not require any bolts, nuts, or fasteners for connection to the discharge tube. Stiffening, guides, or other features shall be provided at the pump support to ensure concentric positioning of the pump in the discharge tube. Means shall be provided such that an effective seal is obtained between the pump and discharge tube. The discharge tube shall be provided with a means to support the power and control cables as they run through the tube to the pump. The cables shall not be allowed to "flap" around while the pump is operating. Power cable penetrations shall be watertight.

2.3.3 Flanged Joints.

Design flanged joints to be airtight and watertight, without the use of preformed gaskets, except that the use of a gasketing compound will be permitted. Mating flanges shall be male/female rabbet type or doweled with not less than four tapered dowels equally spaced around the flange. Flanges and drill bolt holes shall be machined concentric with the centerline, having a tolerance of plus or minus 1/4 of the clearance between the bolt and the bolt hole. When fabricated from steel plate, flanges shall not be less than 2.375 inch thick after machining. Flange machining shall not vary more than 10 percent of the greatest flange thickness. Fabricated flanges, as a minimum, shall be constructed to the dimensions of AWWA C207-94, Class B. Flanges shall be connected to the discharge elbow with two continuous fillet welds, one at the inside diameter of flange-to-pump-tube and the other at the outside diameter of pump-tube-to-flange. Weld design is the pump manufacturer's responsibility. Mating flanges shall be machined parallel to a tolerance of 1/64-inch. The machine mating flange surface shall be finished to 125 microns or better.

2.3.4 Nuts and Bolts.

Nuts and bolts shall be of the hexagonal type. Bolts, including assembly, anchor, harness, and dowels, shall be 300 stainless steel. Nuts shall be bronze; washers shall be 300 series stainless steel.

2.3.5 Bolted Cover.

A watertight cover shall be provided and bolted to the top of the discharge tube. The cover shall include a lifting eye or eyes to enable a hoist hook to be attached for lifting and removal.

2.3.6 Dissimilar Metals.

When dissimilar metals are used in intimate contact, suitable protection against galvanic corrosion shall be applied. The anodic member shall be protected by proper electrical insulation of the joint.

2.4 PAINTING.

The pump/motor shall be painted in accordance with the pump manufacturer's standard coating system. The painting of the discharge tube and discharge elbow and appurtenances shall be in accordance with Section, PAINTING: HYDRAULIC STRUCTURES.

2.5 SHOP ASSEMBLY.

The discharge tube and discharge elbow shall be assembled in the manufacturer's plant to ensure the proper fitting and alignment of all parts. Prior to disassembly, all parts shall be match-marked to facilitate the correct assembly in the field.

2.6 NAMEPLATE.

The pumping unit shall be identified by means of a separate nameplate permanently affixed in a conspicuous location. The plate shall bear the manufacturer's name, model designation, serial number if applicable, and other pertinent information such as horsepower, speed, capacity, type, and direction of rotation. The plate shall be made of corrosion-resistant metal with raised or depressed lettering and a contrasting background.

2.7 INSTRUCTION PLATES.

The pumping unit shall be equipped with suitably located instruction plates, including any warnings and cautions, describing any special and important procedures to be followed in starting, operating, and servicing the equipment. Plates shall be made of corrosion-resistant metal with raised or depressed lettering and a contrasting background.

2.8 PERFORMANCE/CAVITATION TESTS.

2.8.1 General.

A prototype pump for each pump station or an exact model of the proposed pumps for each pump station shall be tested at the manufacturer's test facility to demonstrate that the proposed pumps operate without instability and comply with specified performance and Net Positive Suction Head Available (NPSHA). Instability is defined when any point in the usable range of the head-capacity curves cannot be repeated within 3 percent or when a test point deviates from the normal curves by 2 percent. When this occurs, the test shall be rerun. Compliance with specifications will be determined from curves required by the paragraph TEST RESULTS. Test procedures, except as herein specified, shall be in accordance with applicable provisions of HI 1.6, HI 2.6 and HI 9.1-9.5. The temperature of the water used for testing shall be approximately the same for all tests run and shall be recorded during test runs. Under no circumstances shall the specified performance and cavitation tests be waived.

2.8.2 Test Set-Up.

2.8.2.1 Model Tests.

Model pumps, if used, shall be homologous to the proposed prototype pumps and shall be installed with the shaft in the vertical position. The model tests, if used, shall be completed within 270 days after date of notice to proceed.

2.8.2.2 Prototype Tests.

Prototype pumps, if selected, shall be set with the shaft in the vertical position. The tests shall be completed prior to assembling any of the pumps except the one to be tested. The prototype test, if used, shall be completed within 300 days after date of notice to proceed.

2.8.2.3 Test Set-Up Plan.

The performance and cavitation test set-up plans for each pump to be tested shall include dimensioned drawings and cross-sectional views of the test set-up and pump (model or prototype), respectively, with the location of all instruments and the point of their connection shown. Each instrument shall be described in detail giving all data applicable, such as manufacturer's name, type, model number, the certified accuracy, coefficient, ratios, specific gravity of manometer fluid to be used, and smallest scale division. When necessary for clarity, a sketch of the instrument or instrument arrangement shall be included. Also included therein shall be a fully detailed narrative description of each proposed method of instrumentation and the procedures to be used. Included with this narrative shall be a set of sample calculations that show how capacity, heads, power and efficiency are determined using readings from the various measuring devices.

2.8.3 Instrumentation and Procedures.

Each instrument shall be described in detail, giving all data applicable, such as manufacturer's name, type, model number, certified accuracy, coefficient, ratios, specific gravity of manometer fluid to be used, and smallest scale division. When necessary for clarity, a sketch of the instrument or instrument arrangement shall be included. A fully detailed narrative description of each proposed method of instrumentation, procedures to be used, and a sample set of computations shall be included. The lowest equivalent static head that is obtainable with the testing when operating along the head-capacity curve of the proposed pump shall be stated.

2.8.3.1 Head Measurements.

Head measurements shall be made using either a direct reading water column, mercury-air, mercury-water, a Meriam fluid manometer, or a pressure transducer. Vacuums shall be measured with a mercury-air, a mercury-water manometer, or a pressure transducer. Fluctuations shall be dampened sufficiently to permit column gauges or a differential pressure transducer to be read to either the closest one one-hundredth (0.01) of 1 feet of water or Meriam fluid or one-tenth (0.1) in. of mercury. Manometers shall be used as indicated by ISA RP2.1. When pressure transducers are used, their accuracy shall be checked with a manometer.

2.8.3.2 Capacity.

Capacity shall be determined by a calibrated Venturi flowmeter or long-radius ASME flow nozzle. Orifice plates should not be used. Venturi

or nozzle taps should be connected to column gauges equipped with dampening devices that will permit the differential head to be determined to either the closest one-hundredth (0.01) of 1 feet of water or one tenth (0.1) inch of mercury. Magnetic flowmeters and flowmeters utilizing ultrasonic flow measurements will be acceptable if the calibration of the flowmeter has been completed within the last 6 months.

2.8.3.3 Rotational Speed of Pump.

Rotational speed of the pumps shall be measured in accordance with measurement of speed in HI 1.6, HI 2.6 and HI 9.1-9.5, except that revolution counters shall not be used. The device used shall permit the speed to be determined to 1 rpm.

2.8.3.4 Power Input.

Power input to the pumps shall be measured in accordance with power measurements in HI 1.6, HI 2.6 and HI 9.1-9.5. A method to permit Hp to be determined to the closest 1.0 Hp shall be used.

2.8.4 Sump Elevations.

Sump elevations used shall be those specified. Test results with each sump elevation shall meet all specified conditions of capacity, head, Hp and NPSHA.

2.8.5 Performance Tests.

Performance of each size pump to be installed shall be determined by a series of test points sufficient in number to develop a constant speed curve over the range of total heads corresponding to the requirements as stated in section capacities. The range of total heads for the tests for the Quindaro Pump Station pumps shall be from a minimum of 7.0 ft. to a maximum of 29.0 ft. Testing shall be inclusive for the speed involved. Tests for the Quindaro Pump Station pumps shall be made using suction water elevations equivalent to Elev. 740.0 and Elev. 736.0. Testing shall be inclusive for the speed involved. Head differentials between adjacent test points shall not exceed 2.0 feet, but in no case shall less than 10 points be plotted in the pumping range. If the plot of the data indicates a possibility of instability in the head verses capacity curve, a sufficient number of additional test points shall be made to clearly define the head-capacity characteristics. Should the test results indicate that the performance is not the same in all respects for both sump elevations specified, the pump manufacturer shall take whatever corrective action is necessary to produce congruent results. If congruent results cannot be obtained, the test results obtained shall be considered to be those of true pump operation.

2.8.6 Cavitation Tests.

The tests shall include the determination of required net positive suction head (NPSHR) at five or more points on the constant speed curve for each pump size being installed. For the Quindaro Pump Station pumps the NPSHR shall as a minimum be determined at capacities corresponding to prototype capacities of 14,000, 16,000, 18,000, and 20,000 gallons/min. If the pump performance curve indicates that the pump operates at a capacity greater than 20,000 gallons/min when operating at 7.0 feet TDH, the NPSHR at that greater capacity shall also be determined.

2.8.6.1 Test Method.

NPSHR shall be determined using one of the test arrangements shown in HI 2.6 or by using the test set-ups shown in HI 2.6 and varying the speed of the pump. NPSHR shall be the maximum value at which any one or all of the plotted curves, head, horsepower and efficiency depart from the constant values (point of tangency). A sufficient number of points to accurately locate the departure point shall be obtained.

2.8.6.2 NPSHR vs NPSHA.

The value of NPSHR for the Quindaro Pump Station pumps shall be less than the corresponding Net Positive Suction Head Available (NPSHA) over the pumps operating range at total heads from 7.0 feet to 29.0 ft and suction water levels equivalent to the sump elevations specified. NPSHA shall be determined using the temperature of the water in the model test set-up at the time the tests are run and the distance from the water surface to the bottom of the pump suction bell.

2.8.7 Test Results.

Test results shall be plotted to show the total head, static heads, Hp, efficiency and NPSHR as ordinates. The results should be plotted against pump discharge in gal/min as the abscissa. Curves shall be plotted showing pump performance to a scale that will permit reading the total head and NPSHR directly to 0.5 feet, capacity to 500 gal/min, efficiency to 1 percent, and power input to 25 Hp. It shall be established that the performance requirements of these specifications and the warranties under this contract have been fulfilled. The performance test shall be made with the pump and motor assembled as an operating unit to simulate field installation unless otherwise approved in writing by the Contracting Officer. Readings shall be taken at a minimum of five points, including one point each within 2 percent of the rated total head, minimum expected head, and maximum expected head. The tests shall be conducted in accordance with and, unless otherwise specified, use the procedures and instruments used in HI 2.6.

2.8.8 Witness Test.

When the Contractor is satisfied that the prototype performs in accordance with the requirements of the specifications (and the guaranteed values), the Contracting Officer shall be notified that the witness tests are ready to be run and shall be furnished a copy of the test results specified along with a set of sample calculation, including all constants and conversion factors. Thirty days will be required to review this data before the Contracting Officer will be available to visit the Contractor's laboratory for witnessing the test. Should the witness test reveal that the pump does not perform in accordance with the requirements of the specification and the guaranteed values, the Contractor shall make such changes as are required to make it acceptable before again notifying the Contracting Officer that the witness tests are ready to be run. Immediately upon completion of each witness test, copies of all data taken during the test shall be delivered to the Contracting Officer witnessing the test.

2.8.9 Factory Test Report.

The factory test report shall include, as a minimum, the following:

(1) Statement of the purpose of test, name of project, contract

number, and design conditions. Instances where guaranteed values differ from specified values should be given.

(2) Resume of preliminary studies, if such studies were made.

(3) Description of pump and motor, including serial numbers, if available.

(4) Drawings of the test setup showing all pertinent dimensions and elevations and a detailed dimensioned cross section of the pump.

(5) Description of test procedure used, including dates, test personnel, any retest events, and all performance and cavitation test results specified in paragraphs 15161-2.8.6 and 15161-2.8.7.

(6) List of all test instruments with model numbers and serial numbers.

(7) Sample computations (complete).

(8) Conclusions.

(9) Photographic evidence in the form of either 24 color photographs of test equipment, test setup and representative test segments, or a VHS videotape, at least 30 minutes in length, covering the same information as photographs. All photographic evidence should be labeled with contract number, location, date/time, and test activity. Videotape shall be voice annotated with the same information.

(10) Copies of instrument calibration.

(11) Copies of all recorded test data.

(12) Curves showing the performance of the prototype pump.

2.9 MOTOR TESTS.

2.9.1 General.

One motor for each size provided, selected at random, shall be given a complete test. The remainder of the motors shall be given a check test. The Contracting Officer will witness all complete tests unless waived in writing.

2.9.2 Certification.

Certified copies of the results of a complete test for duplicate equipment will be accepted in lieu of the complete test as specified in the above subparagraph for equipment of the respective rating and type. No substitute will be accepted for the check test.

2.9.3 Complete Test.

A complete test of a motor shall include the following:

(l) Excitation Test (no load test).

(2) Performance and Speed-Torque Test (Pony brake or other equivalent pump method).

(3) Cold and Hot Resistance Measurement.

(4) Vibration Measurement In accordance with MG 1-12.06 or MG-1-20.53 of NEMA MG 1.

(5) Conformance Test. In accordance with MG 1-20.48 of NEMA MG 1.

2.9.3.1 Performance Curves.

Performance curves indicating the results of the above tests shall be furnished as follows:

(l) Excitation Tests. Volts as abscissa vs. amperes and watts as ordinates.

(2) Performance Test. Torque or percent load as abscissa vs. efficiency, power factor, amperes, watts, and rpm or percent slip as ordinates.

(3) Insulation Resistance - Temperature Test. Test result values shall be plotted on semilogarithmic graphs, the insulation resistance values as logarithmic ordinates and the temperature values as uniform abscissas.

2.9.3.2 Impedance.

Calculations to determine the impedance of the motor shall be prepared. A curve showing the impedance shall be submitted along with the performance test results specified above. The curve shall have volts as abscissa vs. amperes and watts as ordinates.

2.9.3.3 Speed-Torque.

Calculations to determine the speed-torque performance of the motor shall be prepared. A speed-torque curve shall be submitted along with the performance test results specified above. The curve shall have torque in Newton-meters as abscissa vs. speed in rpm as ordinate.

2.9.3.4 Safety Operating Value

For comparison purposes, a curve indicating the safety operating value of insulation resistance shall be plotted on the same sheet with the insulation resistance - temperature test curve.

2.9.4 Check Test.

A check test of a motor shall include the following:

(l) Routine test per paragraph MG 1-12.51 or MG 1-20.46B of NEMA Pub. No. MG 1.

(2) Cold resistance measurement.

(3) Insulation resistance and winding temperature at time the insulation resistance was measured.

(4) Conformance Test. In accordance with paragraph MG 1-20.48 of

NEMA Pub. No. MG 1.

(5) Vibration measurement in accordance with paragraph MG 1-12.06 or MG 1-20.53 of NEMA Pub. No. MG 1.

2.9.5 Test Reports.

Test reports shall be prepared for each motor. Each report shall consist of the results of each of the individual tests specified.

PART 3 EXECUTION

3.1 INSTALLATION.

Correct installation of the pumping units shall be the Contractor's responsibility and shall be in accordance with the drawings and with the pump manufacturer's installation instruction manuals. The Contractor shall furnish all bolts, shims, tools, and other devices necessary for installing the pumping units. The pump erection engineer shall supervise the complete handling, installation, start-up, and all specified testing of the equipment as required in specification 15161. This shall include the installation of the pump discharge tube. The second pour concrete around the embedded discharge pipe shall be placed after installation of the pump discharge tube is complete and the discharge elbow is connected to the section of discharge pipe.

3.2 CLEANUP PRIOR TO START.

After the pumping units are installed and prior to start-up, complete clean up of the sump areas, including areas behind the trash racks, of any accumulated construction debris shall be done. A representative of the Contracting Officer will witness this final cleaning of these areas. Any damage to the pumping units or related equipment during initial start-up due to foreign objects left in the sump areas shall be corrected at the Contractor's expense.

3.3 PUMP FIELD TESTS.

3.3.1 General.

All field tests shall be at the expense of the Contractor in order to determine if the pumps have been properly installed and connected. All field testing shall be conducted by an experienced pump manufacturer's representative. Before initially energizing the pump/motors, the Contractor shall have successfully tested all pump station control, monitoring, and protective circuits. This thorough electrical checkout procedure shall have followed detailed step-by-step test plans. Dry tests and wet tests shall be conducted on each of the pumping units.

3.3.2 Dry Tests.

3.3.2.1 Quality Control Dry Test.

The Contractor shall conduct a dry test on each pumping unit after installation is complete and after the electric power and control equipment has been installed and all protective settings adjusted to their proper values. The pump erection engineer shall be present for this test. The duration of the test shall be as recommended by the pump manufacturer but shall be not less than two minutes. The Contractor shall record the date

of the test, personnel present, the duration of the test, the power voltage, current for each phase and power factor. The Contractor shall record these values at least once during the test. In addition, the Contractor shall take whatever vibration measurements deemed necessary to ensure compliance with the vibration requirements specified. Should this test reveal a design or installation deficiency or a manufacturing error in pumping unit components, the problem shall be promptly corrected by the Contractor and the tests redone.

3.3.2.2 Quality Assurance Dry Test.

After successful completion of the Quality Control Dry Test and approval of the Quality Assurance Dry Test Plan the Contractor shall conduct a dry test on each pumping unit in the presence of the Contracting Officer or an authorized representative. The pump erection engineer shall be present for this test. Government representatives will take whatever vibration measurements they deem necessary during this test. Should this test reveal a design or installation deficiency or a manufacturing error in pumping unit components or with any component of the system (including the electrical power and control equipment), the problem shall be promptly corrected by the Contractor and the tests redone.

a Quality Assurance Dry Test Plan.

The Contractor shall prepare a plan for each Quality Assurance Dry Test. Each plan shall have a step-by-step procedure for conducting the tests. In addition, all data recorded during each Quality Control Dry Test shall be included with each plan.

3.3.3 Wet Tests.

In order to conduct the wet tests specified it may be necessary to close the gravity drain sluice gates and pond water. This shall be coordinated with the sluice gate manufacturer specified in Division 15.

3.3.3.1 Quality Control Wet Test.

The Contractor shall conduct a wet test on each pumping unit after successful completion of the Quality Assurance Dry Tests. The water level in the ponding area for the Quindaro Pump Station must be no lower than Elev. 739.0 NGVD prior to the start of the test. The water level in the ponding area for the Riverside Pump Station must be no lower than Elev. 739.5 NGVD prior to the start of the test. The pump erection engineer shall be present for the tests. The duration of the test shall be as recommended by the pump manufacturer but shall be not less than 30 minutes unless the ponding area elevation drops below the minimum pumping level. The Contractor shall record the date of the test, the duration of the test, the water level in the ponding area, the power voltage, current for each phase and power factor. The Contractor shall record these values at least every five minutes during the test. Should this test reveal a design or installation deficiency or a manufacturing error in pumping unit components, the problem shall be promptly corrected by the Contractor and the tests redone.

3.3.3.2 Quality Assurance Wet Test.

After successful completion of the Quality Control Wet Test and approval of the Quality Assurance Wet Test Plan the Contractor shall conduct wet tests on each pumping unit in the presence of the Contracting Officer or an

authorized representative. The water level in the ponding area for the Quindaro Pump Station must be no lower than Elev. 739.0 NGVD prior to the start of the test. The water level in the ponding area for the Riverside Pump Station must be no lower than Elev. 739.5 NGVD prior to the start of the test. The pump erection engineer shall be present for this test. The duration of the test shall be not less than 1 hour or until the ponding area elevation drops below the minimum pumping level. Should this test reveal a design or installation deficiency or a manufacturing error in pumping unit components or with any component of the system (including the electrical power and control equipment), the problem shall be promptly corrected by the Contractor and the tests redone.

Quality Assurance Wet Test Plan.

The Contractor shall prepare a plan for each Quality Assurance Wet Test. Each plan shall have a step-by-step procedure for conducting the test, including the ponding of water if necessary. In addition, all data recorded during the Quality Control Wet Test shall be included with each plan.

-- End of Section --

SECTION 15200

DISCHARGE PIPE AND APPURTENANCES
11/99

PART 1 GENERAL

SCOPE. The work provided for herein consists of furnishing all plant, labor, materials and equipment and manufacturing, factory testing, painting, coating, delivering, storing and installing the storm water pump discharge pipes complete with all necessary accessories and appurtenances including the gravity drain flap gates, all as shown on the contract drawings and specified herein.

1.1 Pump Plant Metals
-

1.1.1 Payment

The work includes all labor, equipment, and materials necessary to fabricate, furnish and install pump plant metals including but not limited to ladder rungs, grating, angle iron, expansion anchors, steel plates, screws, gate operator platform, guard railing, chains, and fencing. Cost also includes the fabrication, installation/removal, and storage of stoplogs.

1.1.2 Unit of Measure

Unit of measure: lump sum.

1.2 QUALITY CONTROL.

General. The Contractor shall establish and maintain quality control for all discharge pipe and appurtenant operations to assure compliance with contract requirements and maintain records of his quality control for all construction operations, including but not limited to the following:

(1) All shop fabrication.
(2) Shop coating and painting.
(3) Use of specified materials.
(4) Shop tests.
(5) Preparation for shipment and storage at the worksite.
(6) Inspection at the worksite for damage to and defects in all material and equipment.
(7) Storage at the worksite.
(8) Field coating and painting.
(9) Installation.
(10) Maintenance after installation.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A48-83	Gray Iron Castings
A53-90	Pipe, Steel, Black and Hot-Dipped Zinc-Coated elded and Seamless
A108-90a	Steel Bars, Carbon, Cold-Finished, Standard Quality
A126-84	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A234-92	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
A276-91a	Stainless and Heat-Resisting Steel Bars and Shapes
A582-91	Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished
B21-90	Naval Brass Rod, Bar, and Shapes
B98-84	Copper-Silicone Alloy Rod, Bar, and Shapes
B584-91	Copper Alloy Sand Castings for General Applications
D2000-90	Classification System for Rubber Products in Automotive Applications
F593-91	Stainless Steel Bolts, Hex Cap Crews, and Studs

American Water Works Association (AWWA).

C200-86	Steel Water Pipe 6 Inches and Larger
C206-91	Field Welding of Steel Water Pipe
C208-83	Fabricated Steel Water Pipe Fittings

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Lists of Materials; GA-RE.

The Contractor shall submit three copies of all purchase and mill orders, shop orders and work orders. The Contractor shall submit a list designating the material to be used for each item at the time of submittal

of the shop drawings. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. The Contractor shall also submit a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each piece, the number of pieces, the total weight, and the car initial and number.

Design Requirements, GA-RE.

The Contractor shall submit the manufacturer's design calculations clearly defining all requirements specified herein and shown on the contract drawings.

SD-04 Drawings

Shop Drawings; GA-RE.

The Contractor shall submit complete shop drawings and erection drawings for the sluice gates, for appurtenant items, and for the gate anchorage systems for approval prior to fabricating any gate. Drawings shall include catalog cuts, templates, fabrication, erection and assembly details, and grade and class of materials. Elements of fabricated items inadvertently omitted from contract drawings shall be indicated on submittals.

SD-09 Reports

Quality Control; GA-RE.

When work under this section is being performed, the Contractor shall submit three copies daily of records and tests of workmanship, equipment and materials, as well as records of corrective action taken.

SD-13 Certificates

Materials, Procedures, and Qualifications; GA-RE.

The Contractor shall submit for approval, in triplicate, certification of material tests and analyses, examinations, welding procedures and welding operator qualifications. Test reports for material tests and analyses shall be identified with specific lots and items prior to installation.

1.5 WELDING PROCEDURES

Welding shall be in accordance with Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS

1.6 SHOP DRAWINGS.

Complete shop drawings of the storm water pump discharge pipe and appurtenances for each pump station shall be submitted to the Contracting Officer for approval, in accordance with Special Clause entitled, "Submittals", no later than 180 days after notice of award. Drawings of any items made specially or specifically for this project shall be true shop drawings, but catalog cuts, diagrams, drawings and similar will be sufficient for all standard manufactured items. However, for those items for which true shop drawings are not required, sufficient descriptive data and/or other information, in addition to the catalog cuts, shall be submitted to demonstrate compliance with the specifications. The shop

drawings shall show clearly all information required for connecting, coupling, painting, coating, electrically bonding and installing the discharge pipe and appurtenances and shall specify the materials used. After completion of the installation of the discharge pipe, the Contractor shall submit a complete set of "as-built" information suitable for microfilming.

1.7 WORKMANSHIP.

All workmanship, whether in the factory or the field, shall be performed in a skillful and workmanlike manner by qualified mechanics under competent supervision and direction and in accordance with the best modern practice for the various trades involved and for the manufacture of high-grade material and equipment. All parts shall conform to the shop drawings and shall be free of all defects in either workmanship or materials that will impair their service.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Pipe.

Pipe for the storm water pump discharge line shall be fabricated and tested in accordance with the applicable requirements of AWWA C200. The pipes shall have a nominal outside diameter of 30 inches for the Quindaro Pump Station and 24 inches for the Riverside Pump Station and a minimum wall thickness of 1/2 inch. The discharge pipe shall have a roundness tolerance of plus or minus three thirty-seconds of an inch. The ends of the pipe shall be flange drilled for 125# to accommodate the flap valve specified in Paragraph 6.3 on one end and the stormwater pump discharge tube specified in Paragraph 15100-8.18.3. Vent pipe shall be either welded or seamless steel pipe, black, either meeting the above specification or conforming to the applicable requirements of ASTM A 53. The vent pipes shall have a nominal inside diameter of 4 inches and a 1/2-inch wall thickness.

2.1.2 Fittings and Specials.

Fittings for the vent pipe shall be Schedule 80 seamless steel fittings suitable for welding and conforming to the applicable requirements of ASTM A 234. All connections shall be welded according to the applicable requirements of AWWA C206. Fittings and specials for the storm water pump discharge pipe shall be specially fabricated from the same material as the discharge pipe and in accordance with the approved shop drawings and the applicable provisions of AWWA C208.

2.1.3 Pump Discharge Flap Valves.

The Contractor shall furnish and install at the locations shown on the contract drawings two 30-inch flap valves for the Quindaro Pump Station. The flap valves shall be designed for pump discharge service. The flap valves shall be suitable for mounting on a standard wall flange pipe with the flange drilled for 125 lb. The body and the flap shall be constructed of ASTM A126 Class B cast-iron. The body shall have a groove machined in it, which will have a resilient seat bonded to it. This seat shall be made of neoprene or Bun-N rubber. The hinge arms shall be constructed of high-tensile bronze meeting the requirements of ASTM B584 Alloy C865, with the hinge pins constructed of silicon bronze meeting the requirements ASTM B98 Alloy C865 or Type 304 stainless steel. Each hinge arm shall have two

pivot points with each pivot point being provided with a lubrication fitting. Both pivot points shall be adjustable. The flap valve shall have a steel spring attached to the body, which extends over the flap to limit the travel of the flap during pump operation. A rubber pad shall be provided on the spring at the point of contact. The flap valves shall be similar and equal to Series FV-ACP as manufactured by the Rodney Hunt Co.

2.1.4 Outlet Structure Flap Valves.

The Contractor shall furnish and install on the outlet structures shown on the contract drawings two 108-inch flap valves for the Quindaro Pump Station. The flap valves shall be designed for gravity flow service and for mounting directly to the outlet structure concrete using anchor bolts. The body and the flap shall be constructed of ASTM A126 Class B cast iron. The body shall have a groove machined in it, which will have a resilient seat bonded to it. This seat shall be made of neoprene or Buna-N rubber. The hinge arms shall be constructed of high-tensile bronze meeting the requirements of ASTM B584 Alloy C865, with the hinge pins constructed of silicon bronze meeting the requirements ASTM B98 Alloy C865 or Type 304 stainless steel. Each hinge arm shall have two pivot points with each pivot point being provided with a lubrication fitting. Both pivot points shall be adjustable. The flap valves shall be similar and equal to Series FV-AC as manufactured by the Rodney Hunt Co.

2.1.5 Anchor Bolts.

The anchor bolts for the outlet structure flap valves shall be stainless steel. They shall be either "J-bolts" cast with the outlet structure or HVA adhesive anchors by Hilty Anchoring Systems, Dallas, TX or approved equal. All anchor bolts shall be provided with bronze nuts.

PART 3 EXECUTION

3.1 PAINTING.

3.1.1 General.

The work covered in this paragraph consists of cleaning and painting the storm water pump discharge pipe, vent pipe assemblies and the accessories and appurtenances, in the manufacturers' plants; and the additional or touch-up painting of the storm water pump discharge pipe and appurtenances required at the worksite.

3.1.2 Surfaces Not to be Painted.

Paint shall not be applied to aluminum, rubber, corrosion-resisting steel, non-ferrous, finished or machined surfaces or to galvanized parts. Metal surfaces to be embedded in concrete shall not be painted.

3.1.3 Vent Pipe.

All vent pipe, including fittings, shall be painted with aluminum paint.

3.1.4 Discharge Pipe.

The storm water pump discharge pipes shall be coated inside and out in the manufacturer's plant and in accordance with the applicable provisions of Section, PAINTING: HYDRAULIC STRUCTURES. All coatings shall be touched up

in the field as necessary.

3.1.5 Pump Discharge and Outlet Structure Flap Valves.

The pump discharge and outlet structure flap valves shall be cleaned and painted according to the applicable provisions of Section, PAINTING: HYRDRAULIC STRUCTURES.

3.2 PREPARATION FOR SHIPMENT AND STORAGE AT THE WORKSITE.

Protected pipe shall be handled at all times with equipment such as wide slings and wide padded skids designed to prevent damage to the coating. Bare wire rope, chains, hooks, metal bars and narrow skids shall not be permitted to come in contact with the coating. Prior to shipment any portions of the storm water pump discharge pipe not painted or coated because of future field welding or other installation requirements shall be protected with a coat of rust preventative meeting the applicable requirements of Military Specification MIL-C-16173 for "Grade 2." This coating shall be removed prior to any field welding or coating.

3.3 STORAGE.

Upon delivery at the worksite, and after completion of the field painting, the pipe sections, fittings and specials and the flap valves, may be stored outdoors provided they are stored on wood blocking not less than 8 inches above a base of washed gravel or crushed stone not less than 2 inches thick. Gaskets shall be stored indoors.

3.4 FABRICATION AND INSTALLATION.

Except as specified just below, the storm water pump discharge pipe shall be shop assembled with welded joints and welding fittings. Subject to the approval of the Contracting Officer, a limited amount of field welding will be permitted provided the extent of such field welding is clearly shown on the shop drawings submitted for approval. All field welding shall be performed accordance with the applicable requirements of AWWA C206. The vent pipe assemblies shall be installed as shown on the contract drawings.

3.5 GUARANTEE

Equipment furnished under this Specification section shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, design and workmanship. Upon receipt of notice from the Government of failure of any part of the guaranteed equipment during the guarantee period, a new replacement part or parts shall be furnished and installed promptly by the Contractor at no additional cost to the Government.

-- End of Section --

SECTION 15301

SLUICE & LINE GATES - MISCELLANEOUS DRAINAGE STRUCTURES
11/99

PART 1 GENERAL

The work covered by this section consists of furnishing all plant, labor, material and equipment required to furnish, fabricate, and install new sluice gates, line gates, complete, as specified herein and as shown on the Contract Drawings.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A48	Gray Iron Castings
A108-90a	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A582	Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished
ASTM B21	Naval Brass Rod, Bar, and Shapes
ASTM B98	Copper-Silicone Alloy Rod, Bar, and Shapes
ASTM B584	Copper Alloy Sand Castings for General Applications
ASTM D2000	Classification System for Rubber Products in Automotive Applications
ASTM F593	Stainless Steel Bolts, Hex Cap Crews, and Studs

AMERICAN WATER WORKS ASSOCIATION (AWWA)

C560-00	AWWA Standard For Cast Iron Sluice Gates
AWWA C540	(1993) Power-Actuating Devices for Valves and Sluice Gates

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Lists of Materials; GA-RE.

The Contractor shall submit three copies of all purchase and mill orders, shop orders and work orders. The Contractor shall submit a list designating the material to be used for each item at the time of submittal of the shop drawings. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. The Contractor shall also submit a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each piece, the number of pieces, the total weight, and the car initial and number.

Design Requirements, GA-RE.

The Contractor shall submit the manufacturer's design calculations clearly defining all requirements specified herein and shown on the contract drawings.

Tests, GA-RE

Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedied by the Contractor at no additional expense to the Government, and retests conducted.

FIELD INSTALLATION AND TESTS, GA-RE

SD-04 Drawings

Shop Drawings; GA-RE.

The Contractor shall submit complete shop drawings and erection drawings for the sluice and line gates, for appurtenant items, and for the gate anchorage systems for approval prior to fabricating any gate. Drawings shall include catalog cuts, templates, fabrication, erection and assembly details, and grade and class of materials. Elements of fabricated items inadvertently omitted from contract drawings shall be indicated on submittals.

SD-09 Reports

Quality Control; GA-RE.

When work under this section is being performed, the Contractor shall submit three copies daily of records and tests of workmanship, equipment and materials, as well as records of corrective action taken.

SD-13 Certificates

Materials, Procedures, and Qualifications; GA-RE.

Manufacture certification the equipment furnished meets the contract requirements.

Also the Contractor shall submit for approval, in triplicate, certification of material tests and analyses and examinations. Test reports for material tests and analyses shall be identified with specific lots and items prior to installation.

1.3 QUALITY CONTROL

1.3.1 General

The Contractor shall establish and maintain quality control for the work specified in this section to assure compliance with the contract requirements and shall maintain detailed records of his quality control for construction operations, including but not limited to, the following:

(a) Material;
(b) Fabrication and workmanship; and
(c) Installation.

1.3.2 Certification

The Contractor shall certify that all materials, either specifically manufactured for this work or manufactured as a stock item, conform to the requirements of these Specifications. Such certification will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that may develop before the completion of his work or guarantee. Tests shall be made as indicated in the respective section of the specifications or on the contract drawings and in the presence of the Contracting Officer's Representative (COR). The Contractor shall furnish the COR certified results, in triplicate, of any required test or analyses.

1.4 WORKMANSHIP

1.4.1 General

Workmanship shall be of the highest grade in accordance with the best modern practices to conform to the Specifications for the item of work being furnished.

1.4.2 Commercial Equipment

Commercial equipment furnished under this contract, but not designed specifically for this particular project, shall be the standard product of a manufacturer regularly engaged in the manufacture of equipment of this type; of current manufacture; new and unused; built on the multiple or repetitive system; and suitable for the intended use. The provisions of this section shall not apply to the manufacture of the items themselves, except as specifically directed by the COR.

1.4.3 Reporting

Three copies of these records and tests, as well as records of corrective action taken, shall be furnished to the COR daily when work under this Section is being performed.

1.5 DESIGN REQUIREMENTS

1.5.1 General

The manufacturer shall provide design calculations clearly defining all requirements specified herein and shown on the contract drawings. It is the responsibility of the Contractor to obtain the support of a manufacturer regularly engaged in the manufacture of sluice and line gates for the type of service required under this contract work. All gates shall be of the same manufacture and shall be designed, fabricated and assembled in accordance with standard sizes and gages. All components shall be adequate to withstand, without breakage or deleterious deformation, all stresses encountered during installation or operation under the conditions specified. All components shall be manufactured under the principles of interchangeability.

1.5.2 Gate

Each sluice gate shall be of the upward opening and rising stem type, and be manually operated. All gates shall be cast iron. Design of the sluice gates shall be in conformance with AWWA C560-00 .

All new sluice gates, associated hoists and stems designed and furnished for this work shall be capable of resisting the design seating and design unseating heads given below. The design heads and operating heads are equal and are measured from the horizontal center line of the gate opening to the water surface elevation.

	Gate Number	Operating Media	Closure Type	Gate Size, (in)	Design Seating Head, (ft)	Design Unseating Head, (ft)
QL	GW #2	Storm Sewer	Flush Bottom	48"x48"	24	13
QL	GW #4	Storm Sewer	Conventional	60"x60"	28	0
QL	GW #4A	Storm Sewer	Conventional	60"x60"	20	0
QL	GW #5A	Storm Sewer	Conventional	60"x60"	32	16
RL	GW #6A	Sanitary Sewer	Flush Bottom	66"x66"	40	16
RL	GW #6B	Sanitary Sewer	Flush Bottom	24"x24"	39	16
RL	GW #7	Storm Sewer	Flush Bottom	36"x36"	33	15
RL	GW #8	Storm Sewer	Conventional	42"x42"	33	16
RL	GW #9	Sanitary Sewer	Flush Bottom	72"x72"	43	22
RL	GW #9	Sanitary Sewer	Conventional	18"x18"	40	18
RL	GW #10	Storm Sewer	Flush Bottom	48"x48"	21	5
RL	GW #11	Storm Sewer	Conventional	66"x66"	29	7

Each line gate shall be of the upward opening and nonrising stem type, and be manually operated. All gates shall be cast iron. Design of the sluice gates shall be in conformance with AWWA C501-92.

All new line gates, associated hoists and stems designed and furnished for this work shall be capable of resisting the design seating and design unseating heads given below. The design heads and operating heads are equal and are measured from the horizontal center line of the gate opening to the water surface elevation.

Gate Number	Operating Media	Closure Type	Gate Size, (in)	Design Seating Head, (ft)	Design Unseating Head, (ft)

RL GS-3 Line Line 18 19 10

1.6 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 MATERIALS

The sluice gate frame and disc, stem guides, wall thimbles, pedestals, housings, yokes and retainer bars shall be cast iron, or cast iron containing nickel (Ni-Resist) conforming to ASTM A126, Class B or ASTM A48, Class 30.

Gears shall be steel meeting the requirements of ASTM A108.

The wedges, lifting nut, stem block and stem guide bushings shall be bronze meeting requirements of ASTM B584.

The stem, stem key, wall thimble studs, gate assembly, stop plate and retainer, packing gland mechanism and the lift assembly stop collar shall be stainless steel meeting the requirements of ASTM A276, Type 304.

The gate assembly seating faces and the lift assembly stop nut shall be naval bronze meeting the requirements of ASTM B21.

Fasteners, including anchor bolts, shall be stainless steel meeting the requirements of ASTM F593, Type 304. Nuts shall be silicon bronze meeting the requirements of ASTM B98, Alloy 655.

Seals shall be natural or synthetic rubber conforming to ASTM D2000.

The stem splice shall be stainless steel meeting the requirements of ASTM A582, Type 303.

Resilient seals for flush bottom gates shall be extruded or molded natural or synthetic rubber. Reclaimed rubber shall not be used.

Each rising stem unit shall be provided with galvanized Schedule 40 steel stem cover and cap.

2.1.1 Line Gate

The line gate shall be a Waterman Model H-30-FF or approved equal with a bronze bushed floor box, Type B.

2.1.1.1 Body

Body, bonnet, arch, floor box and cover shall be cast as per ASTM A-126, Class B. Screw, screw nut and packing gland nut shall be free cutting Brass Alloy 360. Seating surfaces for the body and cover shall be bronze seats attached. Non-rising stem shall be bronze. All machined surfaces will have a minimum 63 micro-inch finish. Packing gland body gasket and bonnet gasket shall be cloth inserted rubber. Packing shall be hemp

packing. cast iron body shall be flanged for attachment to pipe as shown on the drawings. A tee handle wrench shall be furnished to turn the operating nut.

PART 3 EXECUTION

3.1 DESIGN

3.1.1 General

The sluice gate, complete with all components, shall be designed, manufactured and supplied by one manufacturer.

3.1.2 Frame

The frame shall be cast iron, of ample section, and cast in one piece to fit the openings shown on the contract drawings. Contact surfaces shall be machined, with the back flange machined to bolt directly to a wall thimble.

3.1.3 Wall Thimble

The wall thimble shall be cast iron and shall be of the configuration (Type E or F) as required to provide a rigid mounting. All thimbles shall be one-piece construction. The front thimble flange shall be machined with tapped holes for the gate frame attaching studs. A mastic supplied by the manufacturer shall be applied to provide a seal between the flange of the sluice gate and the wall thimble during construction. Wall thimbles shall have invert holes to permit satisfactory concrete placement beneath the thimbles.

The vertical centerline shall be marked on the thimble during fabrication to identify the thimble top for correct placement during construction.

	Gate Number	Gate Size, (in)	Thimble Type	Thimble Length (ft-in)	Thimble Shape
QL	GW #2	48"x48"	F	12"	Round to Square
QL	GW #4	60"x60"	F	12"	Round to Square
QL	GW #5A	60"x60"	F	12"	Round to Square
RL	GW #6A	66"x66"	F	12"	Round to Square
RL	GW #6B	24"x24"	F	8"	Round to Square
RL	GW #7	36"x36"	F	8"	Round to Square
RL	GW #8	42"x42"	F	12"	Round to Square
RL	GW #9	72"x72"	E	1'-2"	Square
RL	GW #9	18"x18"	E	1'-8"	Round to Square
RL	GW #10	48"x48"	F	12"	Round to Square
RL	GW #11	66"x66"	F	12"	Round to Square

3.1.4 Disc

The disc shall be one piece cast iron with vertical and horizontal ribs, and with an integrally cast, heavily reinforced stem thrust nut pocket on the vertical centerline and above the horizontal centerline.

3.1.5 Guides, Wedges, and Seals

Guides shall be one-piece cast iron. The guide shall be long enough to retain and support at least one-half of the gate disc in the fully open position. The guide shall also be designed to withstand the total thrust due to water pressure and wedging action.

Gates shall be equipped with side wedges to provide contact between the slide and frame facings when the gate is in closed position. The top and bottom wedges shall be supplied, if required, as determined by the manufacturer.

The resilient seal for flush bottom gates shall be mounted on the disc. Resilient seals mounted on the invert will not be permitted.

3.1.6 Stems

3.1.6.1 Stem, Couplings, and Stem Guides

The stem shall be of sufficient diameter to withstand, without buckling or permanent distortion, the stresses induced by closing the gate and shall be designed to transmit not less than two times the rated output of the hoist with 150 foot-pound torque.

Stem threads shall be either machine-cut or rolled and of the ACME type. The stem and nut threads shall have sufficient contact area so that the contact pressure will not exceed 5,000 psi when the maximum stem thrust is exerted. The stem thread surfaces in contact with the lift nut shall have not rougher than a 63 micro-inch finish. The exterior corners of the threads, either during or after machining, shall be given a slight radius of approximately 0.015-inch in order to prevent them from acting as cutting edges as the stem passes through the lift nut.

The stem shall be of stainless steel, ASTM A 276, Type 304, or ASTM A 582, Type 303 sections joined with bronze couplings which are threaded and keyed. All threaded and keyed couplings of the same size shall be interchangeable.

The stem shall be fitted with a tapped hole in the top end for handling. The tapped hole shall be of sufficient diameter and depth for the insertion of an eyebolt of sufficient strength to pick up the entire stem from a horizontal position.

The stem shall be provided at its lower end with a bronze thrust nut which will fit into the pocket provided therefor on the slide and which will positively prevent rotation of the stem. The stem shall be provided at its upper end with a bronze adjustable stop collar just above the hoist lift nut, and shall be provided with a similar stop collar below the hoist. Stem guides shall be of cast-iron, bronze bushed and mounted on cast-iron brackets. They shall be drilled and slotted so as to be adjustable in two directions and shall be spaced at close enough intervals to support the stem adequately with an L/R ratio of not more than 200 and spaced in accordance with the manufacturer's recommendation for the stem size. After installation of the cover, exposed threads shall be cleaned and degreased and then given a heavy coat of an approved zinc-rich protective coating System NO. 2 of Section PAINTING: HYDRAULIC STRUCTURES.

Stem packing glands shall be mounted to the underside of the top slab of the gatewell structure (Gatewell #9 only). Packing glands shall be installed per manufacturer's instructions.

3.1.6.2 Stem Cover

A stem cover shall be provided. The stem cover shall be of galvanized steel pipe of sufficient diameter and length to permit full travel of the stem without obstruction or binding. The top of the cover shall be closed with a galvanized steel pipe cap. The pipe cap shall have a drilled and tapped hole fitted with an eyebolt of sufficient strength for lifting the assembly from a horizontal position. The stem cover shall have a grease fitting, which can be used for lubricating the stem, installed above the threads used for mounting the cover to the operator. The cover shall be threaded into the top of the hoist to prevent rainwater entry.

Prior to assembly, threaded portions of the stem cover, cap, and eye bolt shall be coated with pipe compound. After installation all exposed threads shall be cleaned and coated with a zinc-rich paint conforming to System No. 2 of Section PAINTING: HYDRAULIC STRUCTURES.

3.1.7 Gate Operator

The manual lifting device shall be crank-operated with either a single or double gear type, and shall have a lift nut threaded to fit the operating stem.

Gears shall be accurately machined with teeth cut to provide smooth, proper operation.

The crank shall be removable and fitted with a corrosion resistant rotating handle which can be removed and stored in a location which will be determined by the COR.

The gate operator shall have a 2" square wrench nut aligned horizontally to accept connection by portable operators.

A position indicator shall be provided to show full open and closed positions divided by a minimum of 1/8 indicator marks. The indicator shall be attached to the lift mechanism.

3.1.8 Portable Operator

Provide two gasoline powered portable operators. The portable operator shall provide a maximum of 50 foot-pounds of torque and be equipped with an overload release clutch set to 70 foot-pounds. The operator shall be capable of operating each gate for the full range of operating conditions and provide closure of the gates within 30 min. The operator shall be operated per manufacturer's requirements. Provide attachment for each operator to drive the 2" square wrench nut located on the gate operator.

3.1.9 Painting

Painting shall be in accordance with Section PAINTING: HYDRAULIC STRUCTURES.

3.1.10 Line Gate

The line gate shall be designed for the installation in the line as shown on the drawings, of the low head, closed line control application. The gate shall be designed and engineered to withstand constant usage over long periods. All cast-iron shall be painted with manufacturer's standard shop coat paint.

3.2 STORAGE

Upon delivery at the work site, bulky parts of the gate, such as the frame, slide and wall thimble, which have been coated with a complete paint system in the manufacturer's plant, may be stored outdoors provided these parts are stored on wood blocking not less than 8 inches above a base of washed gravel or crushed stone not less than 2 inches thick. All other elements of the gate shall be stored in a weathertight building. A framework covered with a plastic film, or any other such expedient or makeshift arrangement, will not be acceptable.

3.3 ERECTING ENGINEER

The Contractor shall furnish the services of a competent erecting engineer to supervise and direct the installation and testing of the gates furnished under this section. The erection engineer shall be present each of the following tasks:

(a) Complete installation of the wall thimble and all other items to be embedded in concrete;
(b) Complete installation of all gate components;
(c) Adjustment of all seals and wedges; and
(d) All specified testing.

The erecting engineer shall be a designated full-time employee of the gate manufacturer and shall have had at least five years of experience with the type of gate furnished under these Specifications. The erecting engineer shall be subject to the approval of the COR. The services of the engineer shall be furnished at no extra cost to the Government. The installation and testing of the gates under the direction and supervision of the erecting engineer shall in no way relieve the Contractor of sole responsibility for the gates meeting all requirements of the Specifications and fulfilling all the Contractor's guarantees.

3.4 FIELD INSTALLATION AND TESTS

3.4.1 Installation

3.4.1.1 General

All installation of the gates and appurtenances shall be in accordance with the manufacturer's installation instructions and under the supervision and direction of the erecting engineer specified. The sluice and line gates shall be installed complete with frames, leaves, stems, adjustable stem guides, floorstands, dustproof stem covers, position indicators, anchor bolts, and all appurtenances necessary to provide a complete and workable installation. All elements of the gate shall be cleaned of all protective coating used thereon during shipment and storage; all rust, dirt, grit and other foreign matter shall be removed. The gate shall then be "touch-up" painted. Each element of the gate shall be carefully and accurately aligned so that after it is fastened in place there will be no binding or excessive pressure or wear in any moving part and no distortion of any member. The wall thimble shall be internally braced during concrete placement. Fasteners shall be tightened uniformly and firmly, but care shall be taken not to overstress either the fastener or the member with which it is associated. Where specific torque values or ranges are cited in the installation instructions, an accurately calibrated torque-wrench, having the proper capacity range, shall be used. Stilson wrenches, cold chisels, or other tools likely to cause injury to the surface of any part, shall not be used in the work of assembly or tightening. All fasteners shall be installed with an anaerobic locking compound similar and equal to that of the LOCTITE Corporation. Cleaning prior to application of the locking compound shall follow the manufacturer's recommendations. All shims shall be of either bronze or corrosion-resisting steel. Where grouting is required, either an epoxy grout or a ready-to-use, non-shrinking grouting material, requiring only mixing with water at the work site, shall be used, and use of any grouting material shall be as recommended by the manufacturer. All blocking and wedges used for support during initial grouting shall be removed prior to final grouting.

3.4.1.2 Wall Thimble

After the concrete from the wall pour for the thimble has hardened and the forms removed, the front surface of the wall thimble should be thoroughly cleaned. Any concrete that has flowed on the surface from the edges shall be carefully removed. Care should be taken to prevent damage to machined surfaces.

3.4.1.3 Gate Installation

Prior to installation, the machined surfaces of the flange and wall thimble shall be thoroughly cleaned and inspected. Care should be taken to prevent damage to machined surfaces. Gasket placement shall be even and thorough. Bolt tightening shall be even and follow manufacturer's recommendations.

3.4.1.4 Line Gate

The installation of the line gate and appurtenances shall be in accordance with the manufactures installation instructions and under the supervision and direction of the erecting engineers specified. The line gate shall be installed complete with body, cover, bonnet, arch, floor box, extension with operating nut and all appurtenances necessary to provide a complete and workable installation.

3.4.2 Tests

The gates shall be operated and tested by and at the expense of the Contractor and under the supervision and direction of the erecting engineer to determine if they have been properly manufactured, assembled and installed and if they meet the requirements of the specifications. The Contractor shall notify the COR at least 5 days prior to commencing the testing. The gates shall be checked in the closed position for leakage. Leakage shall be no greater than 0.1 gallon per minute per foot of perimeter at the specified maximum seating heads. Under the design unseating head, the leakage for heads of 20 feet or less shall not exceed 0.2 gpm per foot of seating perimeter. For unseating heads greater then 20 feet, the allowable leakage shall not exceed the rate per foot of seating perimeter specified by the following equation:

$$Qleak = 0.10 + 0.005 \times hu$$

Qleak = Maximum allowable leakage (gpm per foot of seating perimeter)
hu = unseating head (in feet)

Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedied by the Contractor at no additional expense to the Government, and retests conducted.

3.5 GUARANTEE

Equipment furnished under this Specification section shall be guaranteed for a period of no less than one year from the date of final acceptance thereof against defective materials, design and workmanship. Upon receipt of notice from the Government of failure of any part of the guaranteed equipment during the guarantee period, a new replacement part or parts shall be furnished and installed promptly by the Contractor at no additional cost to the Government.

-- End of Section --

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SECTION 15302

SLUICE GATES AND HOIST - PUMP STATION
11/99

PART 1 GENERAL

The work covered by this section consists of furnishing all plant, labor, material and equipment required to furnish, fabricate, and install new sluice gates, complete, as specified herein and as shown on the Contract Drawings.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 582	Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished
ASTM B 21	Naval Brass Rod, Bar, and Shapes
ASTM B 98	Copper-Silicone Alloy Rod, Bar, and Shapes
ASTM B 344	Drawn or Rolled Nickel-Chromium and Nickel-Chromium Iron Alloys for Electrical Heating Elements
ASTM B 584	Copper Alloy Sand Castings for General Applications (rev 96
ASTM D 2000	Classification System for Rubber Products in Automotive Applications
ASTM F 593	Stainless Steel Bolts, Hex Cap Crews, and Studs

American Water Works Association (AWWA).

AWWA C 501	Cast-Iron Sluice Gates

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA).

MG 1	Motors and Generators (Rev-1 thru 4)

Military Specification.

MIL-C-16173 & Am. 2	Corrosion Preventive Compound, Solvent Cutback, Cold Application

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Lists of Materials; GA-RE.

The Contractor shall submit three copies of all purchase and mill orders, shop orders and work orders. The Contractor shall submit a list designating the material to be used for each item at the time of submittal of the shop drawings. Where mill tests are required, purchase orders shall contain the test site address and the name of the testing agency. The Contractor shall also submit a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each piece, the number of pieces, the total weight, and the car initial and number.

Design Requirements, GA-RE.

The Contractor shall submit the manufacturer's design calculations clearly defining all requirements specified herein and shown on the contract drawings.

SD-04 Drawings

Shop Drawings; GA-RE.

The Contractor shall submit complete shop drawings and erection drawings for the sluice gates, for appurtenant items, and for the gate anchorage systems for approval prior to fabricating any gate. Drawings shall include catalog cuts, templates, fabrication, erection and assembly details, and grade and class of materials. Elements of fabricated items inadvertently omitted from contract drawings shall be indicated on submittals.

SD-09 Reports

Quality Control; GA-RE.

When work under this section is being performed, the Contractor shall submit three copies daily of records and tests of workmanship, equipment and materials, as well as records of corrective action taken.

SD-13 Certificates

Materials, Procedures, and Qualifications; GA-RE.

The Contractor shall submit for approval, in triplicate, certification of material tests and analyses, examinations, welding procedures and welding operator qualifications. Test reports for material tests and analyses shall be identified with specific lots and items prior to installation.

1.3 QUALITY CONTROL

1.3.1 General

The Contractor shall establish and maintain quality control for the work specified in this section to assure compliance with the contract requirements and shall maintain detailed records of his quality control for construction operations, including but not limited to, the following:

(a) Material;
(b) Fabrication and workmanship;
(c) Welding; and
(d) Installation.

1.3.2 Certification

The Contractor shall certify that all materials, either specifically manufactured for this work or manufactured as a stock item, conform to the requirements of these Specifications. Such certification will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that may develop before the completion of his work or guarantee. Tests shall be made as indicated in the respective section of the specifications or on the contract drawings and in the presence of the Contracting Officer's Representative (COR). The Contractor shall furnish the COR certified results, in triplicate, of any required test or analyses.

1.3.3 Workmanship

1.3.3.1 General

Workmanship shall be of the highest grade in accordance with the best modern practices to conform to the Specifications for the item of work being furnished. All workmanship, whether in the factory or the field, shall be performed in a skillful and workmanlike manner by qualified mechanics under competent supervision and direction and in accordance with the best modern practice for the various trades involved and for the manufacture of high-grade machinery. All parts shall have accurately

machined mounting and bearing surfaces so that they can be assembled without fitting, chipping or remachining. All parts shall conform to the design dimensions and shall be free of all defects in either workmanship or material that will impair their service. All attaching bolt holes shall be accurately drilled to the layout indicated on the shop drawings.

1.3.3.2 Commercial Equipment

Commercial equipment furnished under this contract, but not designed specifically for this particular project, shall be the standard product of a manufacturer regularly engaged in the manufacture of equipment of this type; of current manufacture; new and unused; built on the multiple or repetitive system; and suitable for the intended use. The provisions of this section shall not apply to the manufacture of the items themselves, except as specifically directed by the COR.

1.3.4 Reporting

Three copies of these records and tests, as well as records of corrective action taken, shall be furnished to the COR daily when work under this Section is being performed.

1.4 WELDING PROCEDURES

Welding shall be in accordance with Section, METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.5 DESIGN REQUIREMENTS

1.5.1 General

The manufacturer shall provide design calculations clearly defining all requirements specified herein and shown on the contract drawings. It is the responsibility of the Contractor to obtain the support of a manufacturer regularly engaged in the manufacture of sluice gates for the type of service required under this contract work. All gates shall be of the same manufacture and shall be designed, fabricated and assembled in accordance with standard sizes and gages. All components shall be adequate to withstand, without breakage or deleterious deformation, all stresses encountered during installation or operation under the conditions specified and AWWA C 501. All components shall be manufactured under the principles of interchangeability.

1.5.2 GATE.

1.5.2.1 Description.

The gates to be installed shall be as follows:

Each sluice gate shall be of the upward opening and rising stem type, and be electric and manually operated. All gates shall be cast iron. Design of the sluice gates shall be in conformance with AWWA C 501-97.

All new sluice gates designed and furnished for this work shall be capable

of resisting the seating, unseating, and operating heads, and be of the size and type indicated herein.

Location	No. Req.	Opening Size-in.	Ma x. Head-ft.	Operatng Head-ft.	Kind of Pressure	Type of Frame	Type of Operator
Quindaro Pump Station	2	108"W X 108"H	30.0	5.0	Seating	Flat Back W/Wall Thimble	Electric Operator

1.5.2.2 Frame and Guides.

The frame and guides shall be of one piece, cast-iron construction and shall be the flat back type. All contact surfaces shall be machine-finished. The frame shall have machined dovetail-type grooves on its front face to accommodate the seat facings. A machined castiron stop bar shall be bolted and keyed to the frame to form a flush invert and to contain the resilient seal if the seal is not attached to the slide. The back face of the frame shall be drilled and machined to bolt directly to the machined face of the thimble. All bolt holes shall be drilled using templates to match the thimble. The frame shall have integrally cast pads with machined surfaces and keyways to receive the side, wedging devices. The guides shall be conserveratively designed to withstand the total thrust due to the water pressure and the wedging action. A groove shall be machined the full length of the guide to provide sufficient clearance between the slide tongue and the guide groove to permit free movement and ensure proper engagement of the wedging devices. The guides shall be sufficiently long to retain and support at least one-half of the slide when the gate is in the full-open position.

1.5.2.3 SLIDE.

THE SLIDE SHALL BE SQUARE AND OF ONE-PIECE, CAST-IRON CONSTRUCTION WITH INTEGRALLY-CAST VERTICAL AND HORIZONTAL RIBS AND A REINFORCED SECTION AROUND THE PERIMETER TO PROVIDE FOR THE SEAT FACINGS. THE SLIDE SHALL HAVE MACHINED DOVETAIL-TYPE GROOVES ON ITS SEATING FACE TO ACCOMMODATE THE SEAT FACINGS. A MACHINED, SPECIALLY-SHAPED LIP SHALL BE PROVIDED ON THE BOTTOM RIB OF THE SLIDE TO ACCOMMODATE THE RESILIENT SEAL UNLESS THE RESILIENT SEAL IS CONTAINED IN THE FRAME STOP BAR. A TONGUE SHALL BE PROVIDED ON EACH SIDE OF THE SLIDE, SHALL EXTEND ITS FULL LENGTH AND SHALL BE MACHINED ON ALL SIDES TO PROVIDE SUFFICIENT CLEARANCE BETWEEN THE TONGUE AND THE GUIDE GROOVE TO PERMIT FREE MOVEMENT. THE OVERALL CLEARANCE SHALL BE NOT MORE THAN 1/16-INCH. INTEGRALLY CAST PADS SHALL BE PROVIDED AND MACHINE-FINISHED TO RECEIVE THE WEDGES. A STEM NUT POCKET SHALL BE CAST INTEGRALLY ON THE VERTICAL CENTERLINE AND ABOVE THE HORIZONTAL CENTER AND SHALL BE SHAPED TO RECEIVE THE STEM NUT.

1.5.2.4 Wedging Devices.

The gate shall be provided with sufficient side wedging devices to limit leakage to 0.1 gallon per minute per foot of perimeter at the specified

maximum seating heads. The wedging devices shall be of solid cast bronze, machine-finished on all contact surfaces and keyed to the cast-iron pads to maintain adjustment. The wedging devices shall be attached with either bronze or stainless steel studs and bronze nuts, and the adjustable element shall be provided with a bronze adjusting screw with either a bronze lock nut or another approved locking device.

1.5.2.5 Seat Facings.

Seat facings, except for the bottom resilient seal, shall be of extruded bronze. The facings shall be of a special shape which, when impacted into place, will fill and be locked permanently into the dovetail-type grooves in the frame, and slide. Other methods of attachment will not be permitted. The width of the facing shall be not less than 1-inch. After attachment, the facings shall be machined to a plane surface and to at least a 63 micro-inch finish. When the slide is in the fully closed position and wedged into position against the frame, the maximum clearance between the seating faces shall not exceed 0.004-inch.

1.5.2.6 Wall Thimble.

The wall thimble shall be of one-piece, cast-iron construction and of "F" cross section as shown on the contract drawings, and provided with an integrally-cast ring or water stop. The front flange face shall be machine-finished to a plane surface and provided with tapped holes, using a template to match the drilling of the frame. The thimble shall be not less than 18 inches long. The vertical centerline shall be clearly shown by permanent marks at the top and bottom of the machined surface and the word "TOP" shall be permanently marked thereon. The thimble shall be provided with holes in each entrapment zone formed by the reinforcing rips or the flange and waterstop to permit satisfactory concrete placement. A permanent gasket of uniform thickness shall be provided to form a seal between the front face of the thimble and the back face of the frame.

1.5.2.7 Stem, Couplings, and Stem Guides.

The stem shall be of sufficient diameter to withstand, without buckling or permanent distortion, the stresses induced by closing the gate and shall be designed to transmit not less than two times the rated output of the hoist with a 40-pound effort on the crank and 1.25 times the stall output thrust of the fixed motor operated hoist. Stem threads shall be either machine-cut or rolled and of the ACME type. The stem and nut threads shall have sufficient contact area so that the contact pressure will not exceed 5,000 psi when the maximum stem thrust is exerted. The stem thread surfaces in contact with the lift nut shall have not rougher than a 63 micro-inch finish if machine cut and not rougher than a 32 micro-inch finish if roll-formed. The exterior corners of the threads, either during or after machining, shall be given a slight radius of approximately 0.015-inch in order to prevent them from acting as cutting edges as the stem passes through the lift nut. The stem shall be of stainless steel, ASTM A 276, Type 304, or ASTM A 582, Type 303 sections joined with bronze couplings which are threaded and keyed. All threaded and keyed couplings of the same size shall be interchangeable. The stem shall be fitted with a tapped hole in the top end for handling. The tapped hole shall be of sufficient

diameter and depth for the insertion of an eyebolt of sufficient strength to pick up the entire stem from a horizontal position. The stem shall be provided at its lower end with a bronze thrust nut which will fit into the pocket provided therefor on the slide and which will positively prevent rotation of the stem. The stem shall be provided at its upper end with a bronze adjustable stop collar just above the hoist lift nut, and shall be provided with a similar stop collar below the hoist. Stem guides shall be of cast-iron, bronze bushed and mounted on cast-iron brackets. They shall be drilled and slotted so as to be adjustable in two directions and shall be spaced at close enough intervals to support the stem adequately with an L/R ratio of not more than 200. After installation of the cover, exposed threads shall be cleaned and degreased and then given a heavy coat of an approved zinc-rich protective coating System NO. 2 of the Painting: Hydraulic Structures Specifications Section in Division 9 Finishes.

1.5.2.8 Fasteners.

All fasteners shall be of either silicon bronze or stainless steel. Stainless steel bolts and studs shall be provided with bronze nuts. The quantity and size of fasteners shall be as recommended by the gate manufacturer.

1.5.2.9 Anchors.

New anchor bolts shall be installed for the stem guides, The anchor bolts shall be stainless steel provided with bronze nuts. The quantity, size, and minimum pullout strength of the anchors shall be as recommended by the manufacturer. The replacement anchors shall be HVA adhesive anchors by Hilty Anchoring Systems, Dallas, Texas or approved equal.

1.5.2.10 Stem Cover.

A stem cover shall be provided. The stem cover shall be of galvanized steel pipe of sufficient diameter and length to permit full travel of the stem without obstruction or binding. The top of the cover shall be closed with a galvanized steel pipe cap. The pipe cap shall have a drilled and tapped hole fitted with an eyebolt of sufficient strength for lifting the assembly from a horizontal position. The stem cover shall have a grease fitting, which can be used for lubricating the stem, installed above the threads used for mounting the cover to the operator. The cover shall be threaded into the top of the hoist to prevent rainwater entry. Prior to assembly, threaded portions of the stem cover, cap, and eye bolt shall be coated with pipe compound. After installation all exposed threads shall be cleaned and coated with a zinc-rich paint conforming to System NO. 2 of Section, PAINTING: HYDRAULIC STRUCTURES.

1.5.3 ELECTRIC MOTOR-OPERATED GATE HOIST.

1.5.3.1 General.

Each gate shall be raised and lowered by means of an individual electric motor hoist units driven by an electric motor and mounted on the operating platform, as shown on the contract drawings and over ride for manually operated. The unit shall consist of complete, compact, rugged assemblies

specially designed and manufactured for the required service by a manufacturer regularly engaged for at least 5 years in the production of this type of device, and shall be delivered completely wired, assembled and ready for installation. All parts of the lift mechanism shall be designed to move the gate slide at a rate of approximately 12-inches per minute under the specified operating head condition.

1.5.3.2 Motor-Operator-Hoist Assembly.

The electric motor for the gate hoist shall have a continuous duty rating, be suitable for operation on a 240/480-volt, 3-phase, 60-Hz circuit, have sufficient horsepower to operate the hoist unit through the full gate travel in both directions without exceeding the full-load ampere rating, and conform to applicable requirements of NEMA MG 1. All bearings shall be the anti-friction type. The motor shall be provided with moisture protection by a totally-enclosed type enclosure with a winding heater. The heater shall be designed to be connected to the 120V, 1-phase, 60-Hz circuit provided and shall be of the type specified. Operator limit switches, torque switches and unit wiring shall be provided in accordance with DIVISION 16 - ELECTRICAL. All components including the motor, reversing contactors and overload relays, pushbuttons, indicating lights, control transformer, reductions gearing, stem lift nuts, bearings and limit switches, shall be enclosed in NEMA Type 4 enclosures and mounted on a cast-iron pedestal with flanged base plate, complete with corrosion-resisting steel anchor bolts and silicon bronze or stainless steel nuts. Reduction gearing shall consist of generated helical gears of heat treated steel. Worms shall be of hardened alloy steel with threads ground and polished. The worm gear shall be in one piece of chilled nickel bronze, accurately cut. All reduction gearing shall run in lubricant. All gears, the stem lift nuts and other working components shall be carried on heavy-duty ball or tapered roller bearings adequate for all torque and thrust loads imposed by operation of the gate at the specified maximum heads. Suitable seals shall be provided at all points as required to retain the lubricant. The motor-operator shall be of such design as to permit manual operation of the unit in event of power failure or as necessary during servicing. A handwheel shall be provided, and an arrow with the word "OPEN" shall be cast on the rim of the wheel, indicating the direction of opening. Effort required to operate the hoist manually with the gate in motion shall not exceed 25 pounds at the wheel rim. The motor operator shall include a built-in clutch mechanism so that the handwheel will not rotate during motor operation nor shall the motor turn during manual operation. A dial-type indicator shall be located at the top of the motor-operator to show gate position during both hand and motor operation. The indicator shall be graduated to show "FULL OPEN" when the bottom of the gate is at the fully open position. The indicator shall be housed in a watertight enclosure. Indicators which are of the 3-position type showing fully open, fully shut or in an intermediate position are not acceptable. The operator shall be able to watch the indicator from the same position he stands in to operate the controls. The operating unit shall include a built-in, lost-motion device which will permit the motor to attain full speed after which a hammer blow shall be imparted to the hoisting mechanism to initiate gate motion in either the opening or closing direction of travel. The lift nuts shall be bronze, made in two pieces with accurately machined splines or keys and threads. The two-piece nut shall consist of an

outer member, having a flange or flanges on the exterior and splines on the interior, which mates with an inner member having splines on the exterior and threads on the interior. The outer member shall be mounted in the unit housing. The inner member shall be secured to the outer member by either a threaded retainer ring or another suitable arrangement. After the gate has been either completely closed or securely supported in the partially-open position, this inner member shall be capable of being easily removed by disassembling its retaining arrangement and turning the handwheel. Each stem nut shall be adequately designed, factory tested and inspected with the stem with which it will operate. Each nut shall be run by hand throughout the length of the stem with which it will operate. Suitable marks shall be used to identify the matched sets once they have been established in the shop. The internal thread shall have the lower or non-working face relieved 1/64-inch to ensure that the threads will bottom out before wedging can occur. The lift nut shall be drilled or otherwise provided with adequate oil recesses and passages to ensure passage of lubricant to all interior threaded surfaces of the nut. The internal arrangement of the motor hoist units shall be such that all moving parts run in lubricant, with adequate fittings and seals provided to retain the lubricant. The lubricant shall be as recommended by the gate hoist manufacturer. Provision for future installation of stem oilers shall be provided.

1.5.3.3 Limit Switches

The closing and opening travel of the gate shall be protected against overload by a torque-responsive mechanical switch. There shall also be provided geared limit switches for stopping the gate at both the fully closed and the normal fully open positions. The torque switch shall be operative during the entire travel of the gate to protect the stem and gate against possible damage in the event an obstruction is met. The torque switch shall function without auxiliary relays or other devices and shall be field-adjustable to ensure (1) stopping the lowering operation of the gate should the stem load for any reason become compressive to a degree greater than the normal seating requirements, and (2) stopping the raising operation should the stem tension become greater than the normal unseating requirements. The position limit switch shall be adjustable and of the intermediate gear type, governed by rotation of the actuator output worm. Internal motor control wiring for 120-volt operation and motor power wiring for 480-volt, 3-phase, 60-Hz operation shall be provided complete to a suitable terminal block in the limit switch compartment, and terminal blocks shall be clearly marked in a suitable manner to facilitate external control and power connections under another section of these specifications. All internal wiring shall be not smaller than No. 12 stranded copper conductor with not less than 3/64-inch thick "NEOPRENE" or equal insulation and not less than a 1/64-inch thick "NEOPRENE" or equal jacket. Limit switch shall have four pairs of normally open and normally closed contacts. Two pairs for control circuit, one local indication and one for future supervisory control.

1.5.3.4 Control Units.

In addition to the limit switches, provide the following individually mounted controls. Mount all controls, , on side of limit switch compartment

door with hinged, padlockable, vandal resistant cover of at least 1/8-inch plate thickness and of NEMA Type 4 construction.

(1) Selector switch: Heavy duty, button operated, three-position type with legend plate. The three positions shall be labeled as OPEN-STOPCLOSE.

(2) Pilot Lights: Push-to-test type with interchangeable lenses and lamps and of the quantities, colors, connection and legend plates as shown on the electrical drawings; Three individual lighted indicators; green for fully opened, yellow for all positions between open and closed, and red for the fully closed position.

(3) Legend Plates: Made of corrosion-resistant metal with permanent marking made by machine engraving or machine stamping; hand engraving, such as would be done with an engraving pencil, is not acceptable.

1.5.3.5 Space Heaters.

a. Motor heaters

Motor heaters shall be installed in the lower section of the frame or wrapped around the winding end turns. Limit switch compartment heaters shall be installed in the lower portion of the housing. They shall be designed for operation on a 120-volt, single-phase, 60-Hz circuit and of sufficient capacity or wattage that, when energized, they will hold the temperature of the motor windings and limit switch housing approximately 10 degrees C above the ambient temperature.

b. Heaters

The heaters, except for the wrap-around type, shall be the tubular type, constructed with a chromium-nickel heating element embedded in a refractory insulating material, and encased in an approved watertight metal sheath. They shall be designed for continuous operation and to withstand at least 10 percent over-voltage continuously. The rate of heat dissipation shall be uniform throughout the effective length of the heater. Cartridge-type heaters of equivalent construction, as approved by the Contracting Officer, will be acceptable. Heaters installed around the motor winding end turns shall consist of three required turns of heating cable wrapped around the end turns and secured in place before the winding is impregnated.

c. Heating element

The heating element materials shall meet the applicable requirements of ASTM B 344 for an 80 percent nickel and 20 percent chromium alloy.

d. sheath

The sheath shall be a corrosion-resisting, non-oxidizing metal and shall have a wall thickness not less than 0.025-inch.

e. Insulation

Insulation shall be a granular mineral refractory material, highly

resistant to heat, and shall have a minimum specific resistance of 1,000 megohms per inch cubed at 1,OOOF. Insulation for the heating cable winding wrap-around type heaters shall be suitable for a conductor temperature of 180C.

f. Terminals

Terminals of the motor heater and limit switch heater, including the leads, shall be watertight and shall be provided with leads suitable for making connections to the terminal box provided for the stator leads and limit switch leads.

g. tested

Each unit shall be tested at the factory for successful operation and dielectric strength.

1.5.3.6 Design Data for Sluice Gate Stem and Actuator.

a. The following calculations and data shall be included in the shop drawings in compliance with the requirements.

loads

b. The maximum required stem opening and closing loads (in pounds), based on an operating speed of 1 foot per minute.

c. Stem Design.

(1) Solid Stem Diameter.

(2) Threaded Stem root diameter.

(3) Thread pitch and lead.

(4) The longest unsupported length of solid stem.

(5) The longest unsupported length of threaded stem.

(6) Stem factor to convert stem thrust to lift nut torque (Based on a coefficient of friction of 0.2).

(7) Location of stem guides

(8) Maximum recommended load on the weakest section and the 1/r ratio of the that section.

d. Manual Actuator.

The manufacturer's published thrust output rating of the submitted actuator, using the selected stem configuration and a 40 pound pull on its standard handwheel.

e. Fixed Electric Actuator.

(1) Overall ratio of actuator.

(2) Actuator published maximum mechanical torque rating.

(3) Rated H.P. and RPM.

(4) Full load amps.

(5) Locked rotor amps.

(6) Stall torque.

(7) Running torque under maximum operating head.

f. The torque limit switch capacity and the recommended settings.

1.5.4 ELECTRICAL WORK.

The Contractor shall submit, in accordance with the requirements of Special Clause, entitled "Submittals", for approval by the Contracting Officer, diagrams showing all manual and automatic control and protective and signal devices and any wiring required for the operation of the hoist. All manual and automatic control and protective and signal devices and any wiring required for the operation of the hoist and any control wiring required but not indicated on the electrical plans shall be furnished and installed under this section. Power wiring, including the hoist connections, shall be performed under DIVISON 16 - ELECTRICAL and shall conform to the applicable portions thereof, but shall be supervised under this section. All control wiring shall be connected through terminal blocks. All control wiring shall terminate in junction boxes for connection to the control and power wiring systems. Electrical characteristics shall be as specified either in this section or in DIVISION 16 - ELECTRICAL or as indicated on the contract drawings. Motor starters shall be provided complete with properly sized thermal-overload protection, other equipment at the specified capacity including an allowable service factor, and any other appurtenances necessary for the motor control specified.

1.5.5 NAME PLATES.

Each gate hoist shall be identified by means of a name plate permanently affixed in a conspicuous location. The plate shall bear the manufacturer's name, model designation, serial number, if applicable, and any other pertinent information such as speed, capacity, type, etc. Plates shall be made of corrosion-resisting metal with raised or depressed lettering and contrasting background.

1.5.6 INSTRUCTION PLATES.

As necessary, each hoist shall be equipped with suitably located instruction plates, including any warnings and cautions describing any special and important procedures to be followed in starting, operating, and servicing the equipment. Plates shall be made of corrosion-resisting metal

with raised or depressed lettering and contrasting background.

1.5.7 OPERATION AND MAINTENANCE MANUAL AND PARTS LISTS.

1.5.7.1 Manual.

The Contractor shall furnish 7 copies of a manual containing complete information in connection with the operation, lubrication, adjustment, routine and/or special maintenance, disassembly, repair and reassembly of the gate hoist furnished under this section.

1.5.7.2 Parts Lists.

The Contractor shall furnish 7 copies of the manufacturer's spare parts lists and/or bulletins for each item of mechanical equipment furnished under this section. These lists and/or bulletins shall clearly show all details and parts, and all parts shall be adequately described and/or have proper identification marks.

1.5.7.3 General.

The operation and maintenance manual and parts lists shall be bound separately, shall be approximately 8-1/2 inches by 11 inches, printed on good quality paper and bound between flexible, durable covers. Drawings incorporated in the manual and/or parts lists may be reduced to page size provided they are clear and easily legible, or may be folded into the manual to page size. Photographs and/or catalog cuts of components may be included for identification. The operation and maintenance manual and parts lists shall be submitted at the time of shipment of the gate and hoist.

1.6 Gasoline Engine System

The Contractor shall provide one hand held two-cycle gasoline engine system with adapters capable of raising and lowering all individual sluice gates. The unit shall consist of complete, compact, rugged assemblies specially designed and manufactured for the required service by a manufacturer regularly engaged for at least 5 years in the production of this type of device, and shall be delivered completely operational, assembled and ready for operation. The device shall be designed to operate any sluice gate at a rate of no less than 12-inches per minute under any operating head condition.

1.7 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 MATERIALS

All materials shall be free from defects and imperfections, of recent manufacture and unused, and of the classifications and grades specified herein unless otherwise approved by the Contracting Officer. Material not specifically described shall, as far as practicable, conform to the latest specifications of the American Society for Testing and Materials. All materials, supplies and articles not manufactured by the Contractor shall be the products of recognized reputable manufacturers. Samples of materials shall be submitted for approval when so directed. Equipment, materials and articles installed or used without such approval shall be at the risk of subsequent rejection.

2.1.1 Iron Castings

Material for iron castings shall meet the applicable requirements of either ASTM A 48 for Class Nos. 30A, 30B, 30C or ASTM A 126 for Class B.

The sluice gate frame and disc, stem guides, wall thimbles, pedestals, housings, yokes and retainer bars shall be cast iron, conforming to ASTM A 126, Class B or ASTM A 48, Class 30.

2.1.2 Bronze.

Bronze castings for such items as wedges, thrust nuts, lift nuts and couplings shall meet the applicable requirements of ASTM B 584 for Copper Alloy No. 865. Bronze extrusions for seat facings in the frame and slide shall meet the applicable requirements of ASTM B 21 for Copper Alloy No. 464 or No. 482. Bronze for fasteners, adjusting screws and lock nuts shall meet the applicable requirements of ASTM B 98 for Copper Alloy No. 651 or No. 655. Nuts shall be silicon bronze meeting the requirements of ASTM B 98, Alloy 655.

The wedges, lifting nut, stem block and stem guide bushings shall be bronze meeting requirements of ASTM B 584.

The gate assembly seating faces and the lift assembly stop nut shall be naval bronze meeting the requirements of ASTM B 21.

2.1.3 Stainless Steel

The stem, stem key, wall thimble studs, gate assembly, stop plate and retainer, and the lift assembly stop collar shall be stainless steel meeting the requirements of ASTM A 276, Type 304.

Stainless steel rods for anchor bolts, studs, fasteners, and washers shall meet the applicable requirements of ASTM A 276 for Type 302 or 304, or ASTM A 582 for Type 303. Fasteners, including anchor bolts, shall be stainless steel meeting the requirements of ASTM F 593, Type 304.

The stem splice shall be stainless steel meeting the requirements of ASTM A 582, Type 303.

2.1.4 GEARS

Gears shall be steel meeting the requirements of ASTM A 108.

2.1.5 The lifting device

The lifting device shall be manually crank and electric operated as recommended by the manufacturer to be compatible with gate design. A position indicator shall be provided to show the position of the gate at all times. The indicator shall be attached to the lift mechanism.

2.1.6 Seals

Seals shall be natural or synthetic rubber conforming to ASTM D 2000.

PART 3 EXECUTION

3.1 PAINTING.

3.1.1 Gate.

The gate and operator pedestal shall be cleaned and painted in the manufacturer's plant as specified in Section, PAINTING: HYDRAULIC STRUCTURES.

3.1.2 Hoist.

The hoist may be painted with a complete coating system in accordance with the manufacturer's standard practice, in which case it will be exempted entirely from the surface preparation and painting requirements, provided the coating system is approved by the Contracting Officer, is of acceptable color and is touched up as necessary prior to shipment. Requests for such exemption shall be accompanied by a description of the manufacturer's standard coating system, including surface preparation, type of primer and finish coat or coats, dry film thickness and whether baked-on or air-dried.

3.2 LUBRICATION AND LUBRICANTS.

The hoist shall be lubricated prior to any use or operation, either in the shop or in the field. Each bearing shall be lubricated through its associated lubrication fitting, and the gears shall be packed with lubricant at assembly. After shop testing, and prior to shipment, the bearings shall be relubricated. Prior to testing in the shop, and to initial operation in the field, the gate seat facings and wedging devices shall be cleaned of all foreign material and lubricated thoroughly with a light grease. Just prior to field assembly, the lift nut and stem threads shall be lubricated. All lubricants shall be as recommended by the gate and hoist manufacturer and shall be submitted by manufacturer's name and number as part of the shop drawings. At no additional expense to the Government, the Contractor shall furnish an additional 20 pounds of each different hoist lubricant.

3.3 SHOP ASSEMBLY AND TESTS.

After completion of initial machining, the gate shall be completely assembled, in the vertical position, and the wedging devices adjusted to

exclude a 0.004-inch thickness gage between the frame and slide seating surfaces. Any additional machining needed to achieve this condition shall be performed, any discrepancies or deficiencies discovered as a result of this procedure shall be corrected, and a retest conducted. The slide shall be completely opened and closed in the guides several times to ensure that it operates freely. The gate shall then be disassembled to the extent necessary for shipment. The Contractor shall notify the Contracting Officer 72 hours in advance so that a representative of the Contracting Officer may witness the assembly, testing and disassembly work, unless this requirement is waived in writing by the Contracting Officer. The hoist shall be operated manually a sufficient length of time to ensure proper assembly and operation. The electric motor-operated hoist assembly shall be given the standard shop test. Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedied by the Contractor at no additional expense to the Government, and retests conducted.

3.4 PREPARATION FOR SHIPMENT AND STORAGE AT THE WORKSITE.

3.4.1 Preparation for Shipment.

Prior to shipment from the manufacturer's plant, the Contractor shall prepare the gate and hoist for shipment as described herein. All large, bulky and/or heavy elements shall be mounted on skids or pallets of ample size and strength to facilitate loading and unloading. All small parts shall be boxed in sturdy wood or heavy corrugated paperboard boxes. A packing list, indicating the contents of each such box and enclosed in a moisture-proof envelope, shall be securely fastened to the outside of the box. The skid and/or pallet mounting and the boxing shall be done in a manner which will prevent damage to the gate and hoist during loading, shipment, unloading, storage, and any associated and/or subsequent handling. Weatherproof covers shall be provided during shipment to protect all items which the Contracting Officer designates as requiring such protection. Any special slings, strongbacks, skidding attachments, or other devices used in loading the equipment at the manufacturers' and/or fabricators' plants shall be furnished for unloading and handling at the destination and shall become the property of the Government unless otherwise, directed by the Contacting Officer.

3.4.2 Preparation for Storage.

At the conclusion of all shop tests, the gate and hoist shall be protectively processed for not less than 12-month storage either outdoors or indoors as the case may be, at the destination. Bulky parts of the gate not particularly susceptible to damage from exposure, such as the frame, slide, etc., may be stored outdoors. Other parts, such as fasteners, stem, and the complete hoist, shall be stored indoors. The Contractor shall furnish for approval at least 60 days prior to shipment and, in accordance with the requirement of the Submittals, a complete description of the processing method or methods he intends to use, including complete instructions for maintaining the protection during the storage period. Surfaces of items or of portions of items which are to be embedded in or rest on concrete, shall be cleaned of all dirt, rust, and other foreign coatings, not including closely-adhering mill scale, and then coated with a rust preventative meeting the applicable requirements of Mil. Spec.

MIL-C-16173 for "Grade 2." This coating shall be removed before the item is installed on or embedded in concrete.

3.5 STORAGE.

Upon delivery at the worksite, bulky parts of the gate, such as the frame, slide and wall thimble, which have been coated with a complete paint system in the manufacturer's plant, may be stored outdoors provided these parts are stored an wood blocking not less than 8 inches above a base of washed gravel or crushed stone not less than 2 inches thick. All other elements of the gate, and the hoist, shall be stored in a weathertight building. A framework covered with a plastic film, or any other such expedient or makeshift arrangement, will not be acceptable. The motor heaters shall be continuously connected to a 120-volt, single-phase, 60-Hz circuit and provided with a light to indicate that the circuit is complete. The Contractor shall inspect the storage site at least once per day. The Contractor shall submit at least 60 days prior to shipping a detailed description of the proposed storage facilities, and a plan for storage maintenance and inspection, before any storage actually begins.

3.6 ERECTING ENGINEER.

The Contractor shall furnish the services of a competent erecting engineer to supervise and direct the installation and testing of the gates and hoists furnished under this section. The erection engineer shall be present for:

(1) Complete installation of the wall thimble and all other items to be embedded in concrete.

(2) Complete installation of all gate components.

(3) Adjustment of all seals and wedges.

(4) Complete installation and operation of the gate hoists including all wiring and the setting of all the limit switches.

(5) All specified testing.

The erecting engineer shall be a full-time employee of, and designated as such by, the gate manufacturer, shall have had at least five years of experience with the type of gate and hoist furnished under these specifications and shall be subject to the approval of the Contracting Officer. The services of the engineer shall be furnished at no extra cost to the Government. The installation and testing of the gates and hoists under the direction and supervision of the erecting engineer shall in no way relieve the Contractor of sole responsibility for the gates and hoists meeting all requirements of the specifications and fulfilling all the Contractor's guarantees.

3.7 FIELD INSTALLATION AND TESTS.

3.7.1 Installation.

All installation of the gate, hoist and appurtenances shall be in accordance with the manufacturer's installation instructions and under the supervision and direction of the erecting engineer specified. The hoist and all elements of the gate shall be cleaned of all protective coating used thereon during shipment and storage, and all rust, dirt, grit and other foreign matter shall be removed. The gate and hoist shall then be "touch-up" painted as specified in Section, PAINTING: HYDRAULIC STRUCTURES. The hoist and each element of the gate shall be carefully and accurately aligned so that after it is fastened in place there will be no binding or excessive pressure or wear in any moving part and no distortion of any member. The wall thimble shall be internally braced during concrete placement. Fasteners shall be tightened uniformly and firmly, but care shall be taken not to overstress either the fastener or the member with which it is associated. Where specific torque values or ranges are cited in the installation instructions, an accurately calibrated torque-wrench, having the proper capacity range, shall be used. Stilson wrenches, cold chisels, or other tools likely to cause injury to the surface of any part, shall not be used in the work of assembly or tightening. All fasteners shall be installed with an anaerobic locking compound similar and equal to that of the LOCTITE Corporation. Cleaning prior to application of the locking compound shall follow the manufacturer's recommendations. All shims shall be of either bronze or corrosion-resisting steel. Where grouting is required, either an epoxy grout or a ready-to-use, non-shrinking grouting material, requiring only mixing with water at the worksite, shall be used, and use of any grouting material shall be as recommended by the manufacturer. All blocking and wedges used for support during initial grouting shall be removed prior to final grouting.

3.7.2 Tests.

The gate and hoist shall be operated and tested by and at the expense of the Contractor and under the supervision and direction of the erecting engineer to determine if they have been properly manufactured, assembled and installed and if they meet the requirements of the specifications. The Contractor shall notify the Contracting Officer at least 5 days prior to commencing the testing. After the upper stop collar has been adjusted to within 1/16-inch of the operating nut and locked in place with the slide in the fully closed position, and after the lower stop collar has been adjusted against its stop and locked in place, the slide shall be raised and lowered slowly and carefully not less than three times. The gates shall be checked in the closed position for leakage. Leakage shall be no greater than 0.1 gallon per minute per foot of perimeter at the specified maximum seating and unseating heads. Check the motor rotation to ensure that the slide moves in the "OPEN" direction upon activation of the "OPEN" circuit and change the motor leads if necessary. The slide shall be raised manually about three inches prior to initial electric operation. Before the slide is operated electrically through its full travel, both the "OPEN" and "CLOSE" limit switches shall be properly set. The "OPEN" switch shall be adjusted so the opening cycle does not permit the end of the stem thread to enter the lift nut. In addition, the slide shall be blocked in both directions and the torque limit switch settings checked. After all adjustments have been properly made, the slide shall be raised and lowered electrically not less than three times.) Any malfunctions or discrepancies disclosed as a result of these tests shall be promptly remedied by the Contractor at no

additional expense to the Government, and retests conducted. Avoid operation at conditions which overheat the motor of the gate hoist. The duty rating of the motor shall not be exceeded.

3.8 GUARANTEE

Equipment furnished under this Specification section shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, design and workmanship. Upon receipt of notice from the Government of failure of any part of the guaranteed equipment during the guarantee period, a new replacement part or parts shall be furnished and installed promptly by the Contractor at no additional cost to the Government.

The Contractor shall furnish the Government, under separate cover, the manufacturer's standard commercial warranty for the gate and hoist.

3.9 MAINTENANCE.

After completion of the installation, the Contractor shall continue to maintain and protect the gate and hoist and shall keep it ready for operation at any time until acceptance thereof.

-- End of Section --

PHASE II

DIVISION 16 – ELECTRICAL

16370 Electrical Distribution System, Aerial
16375 Electrical Distribution System, Underground
16403 Motor Control Centers, Switchboards and Panelboards
16415 Electrical Work General

SECTION 16370

ELECTRICAL DISTRIBUTION SYSTEM, AERIAL
01/93

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C29.2	(1992) Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	(1986; R 1995) Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	(1989; R 1995) Wet-Process Porcelain Insulators - Strain Type
ANSI C29.5	(1984; R 1995) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types
ANSI C29.6	(1996) Wet-Process Porcelain Insulators - High-Voltage Pin Type
ANSI C29.8	(1985; R 1995) Wet-Process Porcelain Insulators - Apparatus, Cap and Pin Type
ANSI C29.9	(1983; R 1996) Wet-Process Porcelain Insulators - Apparatus, Post-Type
ANSI C37.32	(1996) High-Voltage Air Switches, Bus Supports, and Switch Accessories - Schedules of Preferred Ratings, Manufacturing Specifications, and Application Guide
ANSI C57.12.20	(1994) Transformers, Overhead-Type Distribution Transformers, 500 kVA and Smaller: High Voltage, 34 500 Volts and Below; Low Voltage, 7970/13 800Y Volts and Below
ANSI C135.1	(1979) Galvanized Steel Bolts and Nuts for

	Overhead Line Construction
ANSI C135.2	(1987) Threaded Zinc-Coated Ferrous Strand-Eye Anchor Rods and Nuts for Overhead Line Construction
ANSI C135.4	(1987) Zinc-Coated Ferrous Eyebolts and Nuts for Overhead Line Construction
ANSI C135.14	(1979) Staples with Rolled or Slash Points for Overhead Line Construction
ANSI C135.22	(1988) Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1996) Carbon Structural Steel
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM A 575	(1996) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 228	(1993) Concentric-Lay-Stranded Copper-Clad Steel Conductors
ASTM B 230	(1997) Aluminum 1350-H19 Wire for Electrical Purposes
ASTM B 231	(1995) Concentric-Lay-Stranded Aluminum

	1350 Conductors
ASTM B 232	(1997) Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
ASTM B 398	(1997) Aluminum-Alloy 6201-T81 Wire for Electrical Purposes
ASTM B 399	(1997) Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM B 416	(1993) Concentric-Lay-Stranded Aluminum-Clad Steel Conductors
ASTM D 923	(1997) Sampling Electrical Insulating Liquids
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography.
ASTM F 883	(1997) Padlocks

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C4	(1995) Poles - Preservative Treatment by Pressure Processes
AWPA C25	(1995) Sawn Crossarms - Preservative Treatment by Pressure Processes
AWPA P1/P13	(1995) Standard for Coal Tar Creosote for Land and Fresh Water and Marine (Coastal Water Use)
AWPA P5	(1997) Standards for Waterborne Preservatives
AWPA P8	(1997) Standards for Oil-Borne Preservatives
AWPA P9	(1997) Standards for Solvents for Organic Preservative Systems

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches

IEEE C37.41	(1994; C37.41e) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.60	(1981; R 1992) Requirements for Overhead, Pad Mounted, Dry Vault and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems
IEEE C37.63	(1997) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizer for AC Systems
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13.2	(1991) IEEE Standard Conformance Test Procedures for Instrument Transformers
IEEE C57.15	(1986; R 1992) Requirements, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators
IEEE C57.19	(1991; R 1997) IEEE Standard General Requirements and Test Procedures for Outdoor Power Apparatus Bushings
IEEE C57.19.01	(1991; R 1997) IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1998) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 18	(1992) Shunt Power Capacitors
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1996) IEEE Standard Dictionary of

	Electrical and Electronics Terms
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 404	(1993; errata) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V

INSULATED CABLE ENGINEERING ASSOCIATION (ICEA)

ICEA S-70-547	(1992) Weather Resistant Polyolefin Covered Wire & Cable

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA HV 2	(1991) Application Guide for Ceramic Suspension Insulators
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LA 1	(1992) Surge Arresters
NEMA SG 2	(1993) High Voltage Fuses
NEMA WC 5	(1992; Rev 1) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1991; Rev 1) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1991; Rev 1; Rev 2) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

RURAL UTILITIES SERVICES (RUS)

RUS Bull 1728H-701	(1993) Specification for Wood Crossarms

	(Solid and Laminated), Transmission Timbers and Pole Keys

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions. All equipment shall meet area Seismic requirements.

a. Altitude 750 feet

b. Ambient Temperature -30 to 120 F

c. Seismic Parameters 2a

d. Corrosive Areas entire project

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Fault Current and Protective Device Coordination Study; GA-RE.

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device settings, ratings, or additional labor for installation

of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; GA-RE.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA-RE.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include the item number, the quantity of items proposed, and the name of the manufacturer of the item.

Installation Procedures; GA-RE.

As a minimum, installation procedures for regulators, transformers and reclosers. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-04 Drawings

Electrical Distribution System; GA-RE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings. Detail drawings shall as a minimum include:

a. Constant current regulators.

b. Poles.

c. Crossarms.

d. Surge arresters.

e. Transformers.

f. Automatic circuit reclosers.

g. Pole top switches.

h. Conductors.

i. Insulators.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

As-Built Drawings; GA-RE.

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-09 Reports

Factory Test; GA-RE.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph, "REFERENCES." Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests specified in applicable publications or in these specifications.

Field Testing; GA-RE.

A proposed field test plan 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

FACTORY TESTS; GA-RE.

Test Reports; GA.

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of 5 rings, and including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

SD-13 Certificates

Materials and Equipment; GA-RE.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided under this section of the specifications conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform thereto. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms thereto. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms thereto. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies.

SD-19 Operation and Maintenance Manuals

Electrical Distribution System; GA-RE.

Six copies of Operation and Maintenance manuals electrical distribution system shall be provided, within 7 calendar days following the completion of tests and shall include assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare-parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

Three additional copies of the instructions manual within 30 calendar days following the approval of the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than inch in depth shall not be used.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the Contracting Officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

1.6 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump

sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Products shall conform to the following requirements. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.3 NAMEPLATES

2.3.1 General

Each major component shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Equipment containing liquid-dielectrics shall have the type of dielectric on the nameplate. Nameplates shall be made of noncorrosive metal. As a minimum, nameplates shall be provided for transformers, regulators, circuit breakers, capacitors, meters and switches.

2.3.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric in non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph, "LIQUID DIELECTRICS." Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.4 CORROSION PROTECTION

2.4.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

2.4.2 Ferrous Metal Materials

2.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.4.2.2 Equipment

Equipment and component items, including but not limited to transformers and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The described test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section, PAINTING: HYDRAULIC STRUCTURES.

2.5 CONDUCTORS, CONNECTORS, AND SPLICES

2.5.1 Copper Conductors

Hard-drawn-copper conductors shall comply with ASTM B 1 and ASTM B 8 as appropriate for the conductor size.

2.5.2 Connectors and Splices

Connectors and splices shall be of copper alloys for copper conductors, and a type designed to minimize galvanic corrosion for copper to aluminum-composition conductors. Aluminum-composition and aluminum-composition to copper shall comply with UL 486B, and copper-to-copper shall comply with UL 486A.

2.6 LOW-VOLTAGE LINES

Low-voltage line conductors shall be of the neutral-supported secondary and service drop type with thermoplastic insulation in accordance with NEMA WC 5. Neutral-supported secondary and service drop conductors shall be insulated copper with bare hard-drawn-copper or copper-clad steel neutrals. Conductors on secondary racks may be provided in lieu of neutral-supported cable for pole line circuits where necessary clearances are available.

2.7 POLES AND HARDWARE

Poles shall be of lengths and classes indicated.

2.7.1 Wood Poles

Wood poles shall comply with ANSI O5.1, and shall be pressure treated in accordance with AWPA C4, with creosote conforming to AWPA P1/P13or with oil-borne preservatives and petroleum conforming to AWPA P8 and AWPA P9, respectively, and waterborne preservatives conforming to AWPA P5. Waterborne preservatives shall be either chromated or ammoniacal copper arsenate. Any species listed in ANSI O5.1 for which a preservative treatment is not specified in AWPA C4, shall not be used; northern white cedar, if treated as specified for western red cedar, and western fir, if treated as specified for Douglas fir, may be used. Wood poles shall have pole markings located approximately 10 feet from pole butts for poles 50 feet or less in length, and 14 feet from the pole butts for poles longer than 55 feet in length. Poles shall be machine trimmed by turning smooth full length, and shall be roofed, gained, and bored prior to pressure treatment. Where poles are not provided with factory-cut gains, metal gain plates shall be provided.

2.7.2 Pole Line Hardware

Zinc-coated hardware shall comply with ANSI C135.1, ANSI C135.2, ANSI C135.4, ANSI C135.14 ANSI C135.22. Steel hardware shall comply with ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M. Pole-line hardware shall be hot-dip galvanized steel, except anchor rods of the copper-molten welded-to-steel type with nonferrous corrosion-resistant fittings shall be used. Washers shall be installed under boltheads and nuts on wood surfaces and elsewhere as required. Washers used on through-bolts and double-arming bolts shall be approximately 2-1/4 inches square and 3/16 inch thick. The diameter of holes in washers shall be the correct standard size for the bolt on which a washer is used. Washers for use under heads of carriage-bolts shall be of the proper size to fit over square shanks of bolts. Eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises shall be used wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators.

2.7.3 Guy Assemblies

Guy assemblies shall be zinc-coated steel in accordance with ASTM A 475. Guy assemblies, including insulators and attachments, shall provide a strength exceeding the required guy strength. Three-eye thimbles shall be provided on anchor rods to permit attachment of individual primary, secondary, and communication down guys. Anchors shall provide adequate strength to support all loads. Guy strand shall be 7 strand. Guy material shall be Class A zinc-coated-steel high-strength grade, with a minimum breaking strength not less than 6000 pounds pounds , except where two or more guys are used to provide the required strength. Guy rods shall be not less than 8 feet in length by 1 inch in diameter.

2.8 INSULATORS

Insulators shall comply with NEMA HV 2 for general requirements. Suspension insulators shall be used at corners, angles, dead-ends, other areas where line insulators do not provide adequate strength, and as indicated. Mechanical strength of suspension insulators and hardware shall exceed the

rated breaking strength of the attached conductors.

2.8.1 Low-Voltage Line Insulators

Low-voltage line insulators shall comply with ANSI C29.2 and ANSI C29.3 as applicable. Spool insulators for use on low-voltage lines shall be mounted on clevis attachments or secondary racks and shall be not smaller than Class 53-3. For No. 4/0 AWG and larger conductors, Class 53-5 shall be used. Suspension insulators on clevis attachments used at dead-ends shall be not smaller than Class 52-1.

2.8.2 Strain Insulators for Guy Wires

Strain insulators for use in insulated guy assemblies shall comply with ANSI C29.4 for porcelain or equivalent fiberglass, and shall have a mechanical strength exceeding the rated breaking strength of the attached guy wire. Insulators shall be not smaller than Class 54-2 for lines up to 5 kV, not smaller than Class 54-3 for lines of 6 kV to 15 kV, not smaller than Class 54-4 with two in tandem for lines of 16 kV to 25 kV, and not smaller than Class 54-4 with three in tandem for lines of 26 kV to 35 kV.

2.8.3 Apparatus Insulators

Apparatus insulators shall comply with IEEE C57.19, IEEE C57.19.01, ANSI C29.8, and ANSI C29.9 as applicable.

2.9 CROSSARM ASSEMBLIES

2.9.1 Crossarms

Crossarms shall comply with RUS Bull 1728H-701 and shall be solid wood, distribution type, except cross-sectional area with pressure treatment conforming to AWPA C25, and a 1/4 inch, 45 degree chamfer on all top edges. Cross-sectional area minimum dimensions shall be 4-1/4 inches in height by 3-l/4 inches in depth in accordance with IEEE C2 for Grade B construction. Crossarms shall be 8 feet in length, except that 10 foot crossarms shall be used for crossarm-mounted banked single-phase transformers or elsewhere as indicated. Crossarms shall be machined, chamfered, trimmed, and bored for stud and bolt holes before pressure treatment. Factory drilling shall be provided for pole and brace mounting, for four pin or four vertical line-post insulators, and for four suspension insulators, except where otherwise indicated or required. Drilling shall provide required climbing space and wire clearances. Crossarms shall be straight and free of twists to within 1/10 inch per foot of length. Bend or twist shall be in one direction only.

2.10 AUTOMATIC CIRCUIT RECLOSERS

Automatic circuit reclosers shall comply with IEEE C37.60 and shall be outdoor oil or vacuum type, complete with devices, attachments, and accessories required for installation and operation and shall be suitable for mounting on a single pole. Each recloser shall have continuous current, minimum tripping current, interrupting current, and making current ratings and reclosure times as indicated and shall be rated for the voltage

and phase of the system in which it is installed. Three-phase lockout shall be provided on three-phase circuits. Reclosers shall include provisions for a sequence of not less than three automatic reclosing operations unless otherwise noted, followed by lockout if the circuit fault persists, and for manual opening, closing, and lockout by use of a hookstick. Operating sequence shall be adjustable for 1, 2, 3, and 4 operations to lockout and for combinations of instantaneous operations followed by time delay openings to secure coordination with other reclosers and fuses in the medium-voltage distribution system. Reclosers shall automatically reset within a definite time interval after a successful reclosure and shall be supplied with devices needed to provide the necessary operating power. Hydraulically-controlled reclosers shall be provided with tank drains and sampling valves. Surge arrester protection shall be provided. Reclosers shall be equipped with ground fault tripping equipment.

2.11 CAPACITORS

Capacitor equipment shall comply with IEEE Std 18 and shall be of the three-phase, grounded-wye, outdoor type rated for continuous operation and automatically switched. Equipment shall be suitable for mounting on a single pole. Polychlorinated biphenyl and tetrachloroethylene (perchloroethylene) shall not be used as the dielectric. Equipment shall be rated for the system voltage. Necessary transformers shall be provided for sensing circuit variations and for low-voltage control. Oil-immersed switches shall be provided for automatic switching of capacitors, and shall be electrically separate from ungrounded capacitor enclosures and metal frames. Installations shall include one primary fuse cutout and one surge arrester for each ungrounded phase conductor. Fuse link ratings shall be in accordance with the manufacturer's recommendations. Capacitor equipment, except for low-voltage control and primary fuse cutouts, shall be subassembled and coordinated by one manufacturer. Units, including metal pole-mounting supports and hardware, shall be shipped in complete sections ready for connection at the site. Low-voltage equipment shall be socket or cabinet type, mounted on the pole approximately 4 feet above grade, shall be connected with the necessary wiring in conduit to capacitor equipment, and shall be provided with secondary arrester protection against switching surges when recommended by the manufacturer.

2.12 FUSES AND SWITCHES, MEDIUM-VOLTAGE

2.12.1 Fuse Cutouts

Medium-voltage fuses and cutouts shall comply with NEMA SG 2 and shall be of the loadbreak type construction rated 15 kV and of the normal -duty type. Open-link cut-outs are not acceptable. Fuses shall be either indicating or dropout type. Fuse ratings shall be as indicated. Fuse cutouts shall be equipped with mounting brackets suitable for the indicated installations.

2.12.2 Fused Switches

Fused switches shall be single-pole, manual devices with integral power fuses of the dropout type. Fuse ratings shall be as indicated. Each

switch shall have a continuous current rating as shown, a momentary asymmetrical current rating of 40 kA rms as shown and shall be rated for the voltage of the system in which it is installed.

2.12.3 Nonfused Switches

Nonfused switches shall be single-pole, manual devices with a continuous current rating as shown, a momentary asymmetrical current rating of 40 kA rms as shown, and shall be rated for the voltage of the system in which it is installed.

2.12.4 Group-Operated Load Interrupter Switches

2.12.4.1 Manually Operated Type (Switch Handle Operated)

Manually operated (switch handle operated) load interrupter switches shall comply with ANSI C37.32 and shall be of the outdoor, manually-operated, three-pole, single-throw type with either tilting or rotating insulators. Switches shall be equipped with interrupters capable of interrupting currents equal to the switch's continuous current rating. Each switch shall be preassembled for the indicated configuration and mounting. Moving contacts shall be of the high-pressure, limited-area type, designed to ensure continuous surface contact. Switches shall be fused or non-fused as indicated. Switches shall be complete with necessary operating mechanisms, handles, and other items required for manual operation from the ground. Switch operating handles shall be located approximately 3 feet 6 inches above final grade. Insulation of switch operating mechanisms shall include both insulated interphase rod sections and insulated vertical shafts. Each handle shall be provided with a padlock arranged to lock the switch in both the open and the closed position.

2.13 TRANSFORMERS

Transformers shall comply with IEEE C57.12.00 for general requirements and ANSI C57.12.20 for specific requirements for overhead transformers. Overhead distribution transformers shall be of the outdoor type, mineral-oil-insulated single-phase or three-phase as indicated and have two separate windings per phase. Transformers shall be provided with necessary auxiliary mounting devices suitable for the indicated installation. Transformers shall have four 2-1/2 percent rated kVA high-voltage taps above and below rated primary voltage. Transformer installations shall include one primary fuse cutout and one surge arrester for each ungrounded phase conductor. Self-protected transformers are not acceptable. Transformer tanks shall have a standard gray finish.

2.14 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1 and IEEE C62.1, IEEE C62.2, and IEEE C62.11, and shall be provided for protection of aerial-to-underground transitions, automatic circuit reclosers, capacitor equipment, group-operated load-interrupter switches, transformers and other indicated equipment. Arresters shall be distribution class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the valve type suitable for

outdoor installations.

2.15 VOLTAGE REGULATOR

Voltage regulators shall comply with IEEE C57.15 and shall be of the outdoor, self-cooled, 55/65 degrees C temperature rise, single-phase type. Windings and the load-tap-changing mechanism shall be mineral-oil-immersed. When operating under load, a regulator shall provide plus and minus 10 percent automatic voltage regulation in approximately 5/8 percent steps, with 16 steps above and 16 steps below rated voltage. Automatic control equipment shall provide Class 1 accuracy. Bypass surge arresters shall be suitable for a grounded system and for the associated regulator voltage.

2.15.1 Ratings

Ratings at 60 Hz shall be

Maximum voltage.....12.5 kV

Basic Insulation Level (BIL).....NEC

Current.....3-225 KVA

2.15.2 Bypass and Isolation Switches

Switches shall be of the outdoor, stickhook-operated, single-pole, single-throw, vertical-break type suitable for the indicated mounting. Switches shall be of a type designed to provide bypass of a single-phase regulator circuit by an integral sequence which always occurs when each switch is opened or closed. Each opening sequence shall initially bypass the single-phase regulator circuit, then open the input and output circuits, and finally interrupt the exciting current. Opening any single-phase regulator circuit shall not be possible until after the bypass circuit is closed. Ratings at 60 Hz shall be in accordance with IEEE C37.41.

2.15.3 Miscellaneous

Standard accessories and components in accordance with IEEE C57.15shall be provided. Single-phase units shall be provided with additional components and accessories required by IEEE C57.15 for three-phase units.

2.16 GROUNDING AND BONDING

2.16.1 Driven Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 15 feet in length of the sectional type driven full length into the earth.

2.16.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same

material as the phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.17 PADLOCKS

Padlocks shall comply with Section 08700 'Builders' Hardware.

2.18 WARNING SIGNS

Warning signs shall be porcelain enameled steel or approved equal. Voltage warning signs shall comply with IEEE C2.

2.19 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 tetrachlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 2 parts-per-million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

2.20 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing.

a. Transformers: Manufacturer's standard design tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

d. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.2.

e. Voltage Regulators: Manufacturer's standard tests in accordance with IEEE C57.15.

f. High-Voltage Fuses: Manufacturer's standard tests in accordance with IEEE C37.41.

g. Electric Power Insulators: Manufacturer's standard tests in

accordance with ANSI C29.1.

h.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed in conduits or underground and splices and terminations for medium-voltage cable shall conform to the requirements of Section, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Secondary circuits installed in conduit on poles shall conform to the requirements of Section, ELECTRICAL WORK GENERAL.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of IEEE C2 for heavy loading districts, Grade B construction. No reduction in clearance shall be made. The installation shall also comply with the applicable parts of NFPA 70.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall notify the Contracting Officer of any discrepancy before performing any work.

3.1.3 Tree Trimming

Where lines pass through trees, trees shall be trimmed at least 15 feet clear on both sides horizontally and below for medium-voltage lines, and 5 feet clear on both sides horizontally and below for other lines, and no branch shall overhang horizontal clearances. Where trees are indicated to be removed to provide a clear right-of-way, clearing is specified in Section, CLEARING AND GRUBBING.

3.1.4 Disposal of Liquid Dielectrics

PCB-contaminated dielectric shall be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectric shall not be diluted to lower the level of contamination.

3.2 POLE INSTALLATION

Joint-use electric/roadway-lighting poles for overhead electric and communication lines shall be wood poles utilizing crossarm construction. Cross-arm mounted banked single-phase transformer installations shall be provided. Crossarm construction shall be provided for support of other equipment, except where direct-pole mounting is indicated. Provision for communication services is required on pole-line construction, except where specifically noted otherwise. A vertical pole space of not less than 2 feet shall be reserved at all locations.

3.2.1 Wood Pole Setting

Wood Pole Setting: Wood poles shall be set straight and firm. In normal firm ground, minimum pole-setting depths shall be as listed in Table II. In rocky or swampy ground, pole-setting depths shall be decreased or increased respectively in accordance with the local utility's published standards and as approved. In swampy or soft ground, a bog shoe shall be used where support for a pole is required. Poles in straight runs shall be in a straight line. Curved poles shall be placed with curvatures in the direction of the pole line. Poles shall be set to maintain as even a grade as practicable. When the average ground run is level, consecutive poles shall not vary more than 5 feet in height. When the ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top end and roofed. If any pole is shortened after treatment, the shortened end of the pole shall be given an application of hot preservative. Where poles are set on hilly terrain, along edges of cuts or embankments, or where soil may be washed out, special precautions shall be taken to ensure durable pole foundations, and the setting depth shall be measured from the lower side of the pole. Holes shall be dug large enough to permit proper use of tampers to the full depth of a hole. Earth shall be placed into the hole in 6 inch maximum layers, then thoroughly tamped before the next layer is placed. Surplus earth shall be placed around each pole in a conical shape and packed tightly to drain water away from poles.

TABLE II

MINIMUM POLE-SETTING DEPTH (FEET)

Length Overall Feet	Straight Lines	Curves, Corners, and Points of Extra Strain
20	5.0	5.0
25	5.5	5.5
30	5.5	5.5
35	6.0	6.0
40	6.5	6.5
45	6.5	7.0
50	7.0	7.5
55	7.5	8.0
60	8.0	8.5
65	8.5	9.0
70	9.0	9.5
75	9.5	10.0
80	10.0	10.5
85	10.5	11.0
90	11.0	11.5
95	11.5	12.0
100	12.5	12.5

3.2.2 Pole Setting

Poles shall be mounted on cast-in-place or power-installed screw foundations. . Conduit elbows shall be provided for cable entrances into pole interiors.

3.2.2.1 Power-Installed Screw Foundations

Power-installed screw foundations may be used if they have the required strength, mounting-bolt, and top plate dimensions. Screw foundations shall be of at least 1/4 inch thick structural steel conforming to ASTM A 36/A 36M and hot-dip galvanized in accordance with ASTM A 123/A 123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of screw foundation is permitted. Calculations shall be submitted in accordance with the detail drawings portion of paragraph, "SUBMITTALS."

3.3 CROSSARM MOUNTING

Crossarms shall be bolted to poles with 5/8 inchthrough-bolts with square washers at each end. Bolts shall extend not less than 1/8 inch nor more than 2 inches beyond nuts. On single crossarm construction, the bolt head shall be installed on the crossarm side of the pole. Wood crossarm braces shall be provided on crossarms. Flat braces may be provided for 8 foot crossarms and shall be 1/4 by 1-1/4 inches, not less than 28 inches in length. Flat braces shall be bolted to arms with 3/8 inch carriage bolts with round or square washers between boltheads and crossarms, and secured to poles with 1/2 by 4 inch lag screws after crossarms are leveled and aligned. Angle braces are required for 10 foot crossarms and shall be 60 inch span by 18 inch drop formed in one piece from 1-1/2 by 1-1/2 by 3/16 inch angle. Angle braces shall be bolted to crossarms with 1/2 inch bolts with round or square washers between boltheads and crossarms, and secured to poles with 5/8 inch through-bolts. Double crossarms shall be securely held in position by means of 5/8 inch double-arming bolts. Each double-arming bolt shall be equipped with four nuts and four square washers.

3.3.1 Line Arms and Buck Arms

Line arms and buck arms shall be set at right angles to lines for straight runs and for angles 45 degrees and greater; and line arms shall bisect angles of turns of less than 45 degrees. Dead-end assemblies shall be used for turns where shown. Buckarms shall be installed, as shown, at corners and junction poles. Double crossarms shall be provided at ends of joint use or conflict sections, at dead-ends, and at angles and corners to provide adequate vertical and longitudinal strength. Double crossarms shall be provided at each line-crossing structure and where lines not attached to the same pole cross each other.

3.3.2 Equipment Arms

Equipment arms shall be set parallel or at right angles to lines as required to provide climbing space. Equipment arms shall be located below line construction to provide necessary wire and equipment clearances.

3.4 GUY INSTALLATION

Guys shall be provided where shown, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners, and dead-ends. Where a single guy will not provide the required strength, two or more guys shall be provided. Where guys are wrapped around poles, at least two guy hooks shall be provided and pole shims shall be provided where guy tension exceeds 6000 pounds. Guy clamps 6 inches in length with three 5/8 inch bolts, or offset-type guy clamps, or approved guy grips shall be provided at each guy terminal. Guy-strain insulators shall be provided in each guy for wood poles. Multiple-helix screw anchors shall be provided in marshy ground; rock anchors shall be installed in rock at right angles to guys, elsewhere anchors shall be of an expanding type, except that power installed screw anchors of equivalent holding power are acceptable. A half-round yellow polyvinyl, fiberglass, or other suitable plastic guy marker, not less than 8 feet in length, shall be provided at the anchor end of each guy shown, securely clamped to the guy or anchor at the bottom and top of the marker. Holding capacities for down guys shall be based on a lead angle of 45 degrees.

3.5 CONDUCTOR INSTALLATION

3.5.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Proper care shall be taken in handling and stringing conductors to avoid abrasions, sharp bends, cuts, kinks, or any possibility of damage to insulation or conductors. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.5.2 Connectors and Splices

Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type.

Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.5.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as indicated in TABLE II.

TABLE II

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.5.4 Armor Rods

Armor rods shall be provided for AAC, AAAC, and ACSR conductors. Armor rods shall be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 200 feet, flat aluminum armor rods may be used. Flat armor rods, not less than 0.03 by 0.25 inch shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 0.05 by 0.30 inches. For span lengths of 200 feet or more, preformed round armor rods shall be used.

3.5.5 Low-Voltage Insulated Cables

Low-voltage cables shall be supported on clevis fittings using spool insulators. Dead-end clevis fittings and suspension insulators shall be provided where required for adequate strength. Dead-end construction shall provide a strength exceeding the rated breaking strength of the neutral messenger. Clevis attachments shall be provided with not less than 5/8 inch through-bolts. Secondary racks may be used when installed on wood poles and where the span length does not exceed 200 feet. Secondary racks shall be two-, three-, or four-wire, complete with spool insulators. Racks shall meet strength and deflection requirements for heavy-duty steel racks,

and shall be either galvanized steel or aluminum alloy. Tops of insulator saddles shall be rounded and smooth to avoid damage to conductor insulation. Each insulator shall be held in place with a 5/8 inch button-head bolt equipped with a nonferrous cotter pin, or equivalent, at the bottom. Racks for dead-ending four No. 4/0 AWG or four larger conductors shall be attached to poles with three 5/8 inch through-bolts. Other secondary racks shall be attached to poles with at least two 5/8 inch through-bolts. Minimum vertical spacing between conductors shall not be less than 8 inches.

3.6 TRANSFORMER INSTALLATION

Transformers shall be carefully installed so as not to scratch finishes or damage bushings. Transformers shall be installed in accordance with the manufacturer's instructions. After installation, surfaces shall be inspected and scratches shall be touched up with a finish provided by the transformer manufacturer for this purpose. Three-phase transformer installations shall be installed with in accordance with local practice phase sequence. Primary taps shall be set at requirement.

3.7 CONNECTIONS TO UTILITY LINES

The Contractor shall coordinate the work with the Contracting Officer and shall provide for final connections to the utility electric lines.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to poles by conduit supports spaced not more than 10 feet apart and with one support not more than 12 inches from any bend or termination. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the riser conduit or guard. Cables guards shall be secured in accordance with the manufacturers published procedure. Risers shall be equipped with bushings to protect cables. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable.

3.9 CONNECTIONS TO BUILDINGS

3.9.1 Aerial Services

Connections to buildings shall be made at approximately the point indicated and shall be connected to the service entrance conductors. Supports at buildings shall be adequate to withstand required pulls; supports shall not be rated less than 1000 pounds. Drip loops shall be formed on conductors at entrances to buildings, cabinets, or conduits. Service-entrance conduits with termination fittings and conductors within the building, including sufficient slack for connection to aerial service cables, shall conform to the requirements of Section, ELECTRICAL WORK GENERAL.

3.9.2 Underground Services

Connections to buildings shall be made at the point indicated and shall be

terminated at the service entrance equipment terminals. Cable pulling shall be in accordance with Section 16375, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Service entrance conduits with termination fittings and conductors within the building shall conform to the requirements of Section, ELECTRICAL WORK GENERAL.

3.10 GROUNDING

Noncurrent-carrying metal parts of equipment and conductor assemblies, such as luminaires, medium-voltage cable terminations and messengers, metal poles, operating mechanisms of pole top switches, panel enclosures, transformers, capacitors, recloser frames (cases) and other noncurrent-carrying metal items shall be grounded. Additional grounding of equipment, neutral, and surge arrester grounding systems shall be installed at poles where indicated.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be located approximately 3 feet out from base of the pole and shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade. Multiple rods shall be evenly spaced at least 10 feet apart and connected together 2 feet below grade with a minimum No. 6 bare copper conductor.

b. Pole butt electrodes - Pole butt electrodes shall be installed where indicated, except that this method shall not be the sole grounding electrode at transformer locations. The pole butt electrode shall consist of a coil of at least 12 feet of minimum No. 6 bare copper conductor stapled to the butt of the pole.

c. Plate electrodes - Plate electrodes shall be installed in accordance with the manufacturer's instructions and IEEE C2 and NFPA 70.

d. Ground Resistance - The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, provide additional electrodes interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of 10 feet apart, a single extension-type rod, 5/8 inch 3/4 inch diameter, up to 30 feetlong, driven perpendicular to grade. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notifies immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding Electrode Conductors

On multi-grounded circuits, as defined in IEEE C2, provide a single continuous vertical grounding electrode conductor. Neutrals, surge arresters, and equipment grounding conductors shall be bonded to this conductor. For single grounded or ungrounded systems, provide a grounding conductor for the surge arrester and equipment grounding conductors and a separate grounding conductor for the secondary neutrals. Grounding electrode conductors shall be sized as shown. Secondary system neutral conductors shall be connected directly to the transformer neutral bushings, then connected with a neutral bonding jumper between the transformer neutral bushing and the vertical grounding electrode conductor, as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet. On metal poles, a preformed galvanized steel strap, 5/8 inch wide by 22 gauge minimum by length, secured by a preformed locking method standard with the manufacturer, shall be used to support a grounding electrode conductor installation on the pole and spaced at intervals not exceeding 5 feet with one band not more than 3 inches from each end of the vertical grounding electrode conductor. Bends greater than 45 degrees in grounding electrode conductor are not permitted.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is

energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes shall be provided.

3.11.4 Medium-Voltage Preassembled Cable Test

After installation, prior to connection to an existing system, and before the operating test, the medium-voltage preassembled cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors at one terminal and connecting grounds or metallic shieldings or sheaths of the cable at the other terminal for each test. Prior to the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, and shall not exceed the recommendations of IEEE Std 404 for cable joints unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Low-Voltage Cable Test

For underground secondary or service laterals from overhead lines, the low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations of conductors in the same trench, duct, or cable, with other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable shall then be retested until failures have been eliminated.

3.11.6 Liquid-Filled Transformer Tests

The following field tests shall be performed on liquid-filled transformers 12.5 kVA and above. Pass-fail criteria shall be in accordance with the transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d.

3.11.7 Pre-Energization Services

The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to insure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment and to ensure that packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

Automatic circuit reclosers.

Capacitors.

Switches.

Transformers.

3.11.8 Operating Tests

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph, "SUBMITTALS."

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
11/92

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C37.16	(1988; C37.16a; R 1995) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C37.50	(1989; R 1995) Switchgear, Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures
ANSI C37.72	(1987) Manually-Operated Dead-Front, Padmounted Switchgear with Load-Interrupting Switches and Separable Connectors for Alternating-Current Systems
ANSI C37.121	(1989; R 1995) Switchgear, Unit Substations Requirements
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations

ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVa and Smaller
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.28	(1996) Switchgear and Transformers - Padmounted Equipment - Enclosure Integrity
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 231	(1995) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 400	(1994) Compact Round

	Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 496	(1992) Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM B 609	(1997) Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
ASTM B 609M	(1991) Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes (Metric)
ASTM B 800	(1994) 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers
ASTM B 801	(1995) Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Mahhole Sections (Metric)
ASTM D 923	(1991) Sampling Electrical Insulating Liquids
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2472	(1992) Sulfur Hexafluoride
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994) Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE ANSI/IEEE C37.1	(1994) IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control
IEEE ANSI/IEEE C37.2	(1996) Electrical Power System Device Function Numbers and Contact Designations
IEEE ANSI/IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE ANSI/IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE ANSI/IEEE C37.20.2	(1993; C37.20.2b) Metal-Clad and Station-Type Cubicle Switchgear
IEEE ANSI/IEEE C37.20.3	(1987; R 1992) Metal-Enclosed Interrupter Switchgear
IEEE ANSI/IEEE C37.23	(1987; R 1991) Guide for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus
IEEE ANSI/IEEE C37.30	(1997)Requirements for High-Voltage Switches
IEEE ANSI/IEEE C37.34	(1994) Test Code for High-Voltage Air Switches
IEEE ANSI/IEEE C37.41	(1994; C37.41e) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE ANSI/IEEE C37.63	(1997) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizer for AC Systems
IEEE ANSI/IEEE C37.90	(1989; R 1994) Relays and Relay Systems Associated with Electric Power Apparatus
IEEE ANSI/IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE ANSI/IEEE C37.98	(1987; R 1990) Seismic Testing of Relays
IEEE ANSI/IEEE C57.12.00	(1993) IEEE Standard General Requirements

	for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE ANSI/IEEE C57.13	(1993) Instrument Transformers
IEEE ANSI/IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1993) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1996) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1996) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 404	(1993; errata) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches

NEMA BU 1	(1994) Busways
NEMA FB 1	(1993) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA LA 1	(1992) Surge Arresters
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA SG 2	(1993) High Voltage Fuses
NEMA SG 3	(1995) Power Switching Equipment
NEMA SG 5	(1990) Power Switchgear Assemblies
NEMA TC 5	(1990) Corrugated Polyolefin Coilable Plastic Utilities Duct
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 7	(1990) Smooth-Wall Coilable Polyethylene Electrical Plastic Duct
NEMA WC 7	(1991; Rev 1) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1991; Rev 1; Rev 2) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses

UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 489	(1996; Rev thru Nov 1997) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 510	(1994; Rev thru Nov 1997) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(1996; Rev Jul 1998) Metallic Outlet Boxes
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 857	(1994; Rev thru Nov 1996) Busways and Associated Fittings
UL 1072	(1995; Rev Mar 1998) Medium-Voltage Power Cable
UL 1242	(1996; Rev Apr 1997) Intermediate Metal Conduit
UL 1684	(1996) Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall be as indicated.

b. Altitude 750 feet

f. Seismic Parameters Zone 2

g. Humidity Control 100%

h. Corrosive Areas are highly corrosive atmosphere

i.

1.3 SUBMITTALS

Governmental approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Fault Current and Protective Devices Coordination Studies; GA.

The study shall be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog Data; GA-RE.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA-RE.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures; GA-RE.

As a minimum, installation procedures for transformers, substations, switchgear, and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-04 Drawings

Electrical Distribution System; GA-RE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

b. Transformers.

c. Substations.

d. Switchgear.

e. Pad-mounted loadbreak switches.

f. Busways.

g. Surge arresters.

As-Built Drawings; GA-RE.

The Contractor shall maintain three separate sets of red-lined, full scale, as-built construction drawings marked up to fully indicate as-built

conditions. These drawings shall be maintained in a current condition at all times until completion of the work, and shall be available for review by Government personnel at all times. All variations from the contract drawings, for whatever reason, including those occasioned by modifications, optional materials, and the required coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the contract drawings. In addition, the Contractor shall indicate on the As-Built Drawings, the brand-name, description, location, and quantity of any and all materials used which contain asbestos. The Contractor shall also be responsible for updating the Government-furnished CADD files to reflect the current as-built conditions throughout the duration of the project. The updated CADD design files shall be maintained in the Intergraph Microstation format consistent with the graphic standards established in the CADD contract drawings provided by the Government. The Contractor will be provided a copy of the Tri-Service CADD standards to facilitate his efforts in the maintenance of design files. The updated CADD files shall be reviewed by the Government on a monthly basis during the progress payment evaluation. The Contractor shall be prepared to demonstrate the status of the updated CADD files in his on-site office. The as-built utility drawings shall show locations and elevations of all underground new utilities and existing utilities encountered, including dimensions from permanent structures and/or survey locations. The submittal requirements for as-built utility drawings shall be shown as separate activities on the Contractor-prepared network analysis. Upon completion of the work, the marked-up drawings and the updated CADD files shall be furnished to the Contracting Officer on 8 mm tape or CD. In multiphased construction where portions of a system are to be turned over to the user prior to completion of the project, the marked-up drawings for that portion shall be furnished to the Contracting Officer at that time.(MRD ltr 30 Oct 70 and KCD 8 Apr 91)

SD-09 Reports

Factory Test; GA-RE.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph, "REFERENCES." Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph, "FIELD TESTING" shall be included.

Field Testing; GA-RE.

A proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports; GA-RE.

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each

test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation Reports; GA-RE.

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-13 Certificates

Materials and Equipment; GA-RE.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a

member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Installer Qualifications; GA-RE.

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-19 Operation and Maintenance Manuals

Electrical Distribution System; GA-RE.

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of

producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

1.6 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than

2 ppm PCB content in accordance with paragraph, "LIQUID DIELECTRICS." Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section, PAINTING: HYDRAULIC STRUCTURES.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.1.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

2.4.1.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.1.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.1.4 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.1.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70. Cables in factory-installed, coilable-plastic-duct assemblies shall conform to NEMA TC 5 or NEMA TC 7.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.2 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable

shielding, metallic sheath, and armor.

2.5.2.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

2.5.2.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 20 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application under all roads or where it may be exposed. Low-voltage lines run elsewhere may be direct-burial, thick-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Bituminized Fiber Duct

UL 1684 for Type II (Thickwall).

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.2.3 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably

changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section, ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Watthour Meters

Watthour meters shall conform to ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket mounted outdoor type having a 60 minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.9.2 Protective Relaying

2.9.2.1 General

Solid-state protective relays shall be provided as shown and shall be of a type specifically designed for use on power switchgear or associated electric power apparatus. Protective relays shall conform to IEEE ANSI/IEEE C37.90. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.9.2.2 Construction

Relays shall be dustproof and moisture resistant. Necessary test devices shall be incorporated within each relay and shall provide a means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with an operation indicator and an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.9.2.3 Ratings

Relays shall be the manufacturer's standard items of equipment with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE ANSI/IEEE C37.2.

2.10 GROUNDING AND BONDING

2.10.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 15 feet in length. Sectional type rods may be used.

2.10.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.11 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS. Concrete reinforcing shall be as specified in Section, CONCRETE REINFORCEMENT.

2.12 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.12.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based

thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.12.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.12.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.13 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

2.14 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard design tests in accordance with IEEE ANSI/IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE ANSI/IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C37.34 and IEEE ANSI/IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEEE ANSI/IEEE C37.98. Surge withstand tests in accordance with IEEE ANSI/IEEE C37.90.1.

e. Relaying Current Transformers: Manufacturer's standard tests in

accordance with IEEE ANSI/IEEE C57.13.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C37.20.1, IEEE ANSI/IEEE C37.20.2, and IEEE ANSI/IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

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2.15 FENCING

Fencing shall conform to the requirements of Section, FENCING.

2.16 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.16.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system bused where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.16.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the commercial power company for fault current availability at the site.

2.16.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance

diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.16.4 Fault Current Analysis

2.16.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.16.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.16.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.16.6 Study Report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristics curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current

characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially shall conform to the requirements of Section, ELECTRICAL DISTRIBUTION SYSTEM, AERIAL. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section, ELECTRICAL WORK GENERAL. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section, CAST-IN-PLACE STRUCTURAL CONCRETE FOR CIVIL WORKS.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with paragraph, "SUBMITTALS."

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size,

circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph, "SUBMITTALS." Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Low-voltage cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Direct-Burial

Low-voltage cables shall be buried directly in the earth as indicated. Minimum cover from the top of a cable to finished grade shall be 48 inches.

3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.2.3.2 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 12 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 6 inch layer of backfill shall be of sand. Machine compaction shall not be used within 6 inches of the cable.

3.2.3.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding5 feet in width, such cables shall be installed in concrete-encased ducts. Where

direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.2.3.4 Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.2.3.5 Cable Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. In addition to markers, a 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

3.2.4 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.2.5 Busway Installation

Busways penetrating walls shall have wall flanges installed on both surfaces of walls. Wall openings shall be approximately 1/4 inch larger than the busway on each of the 4 busway sides, and openings shall be sealed with a suitable compound. Fire barriers shall be provided when penetrating fire rated walls. Fire barriers shall have a rating equal to the fire wall rating. A weather barrier shall be used when a busway penetrates an exterior wall. Busways shall be supported at intervals not exceeding 10 feet and shall be braced to prevent lateral movement.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph, "SUBMITTALS." Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 DUCT LINES

3.4.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.4.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.4.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor

shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph, "SUBMITTALS." At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.4.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of 48 inches, but not less than 48 inches below finished grade and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.4.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.4.5.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

3.4.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.4.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.5 MANHOLES, HANDHOLES, AND PULLBOXES

3.5.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.5.2 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch

above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard.

3.6.1 Pole Installation

Pole installation shall be in accordance with Section, ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

3.7 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section, ELECTRICAL WORK GENERAL. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.8 GROUNDING

A ground mat consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, a switchgear ground bus, and a unit substation to the ground mat. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.8.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are

approximately 1 foot below finished grade.

b. Ground mat - A ground mat shall be installed as shown consisting of bare copper conductors installed 24 inches, plus or minus 3 inches, below the finished top of soil grade. Mat conductors shall be bonded to all rod electrodes, electrolytic electrodes, and to all other intersecting mat conductors. Mat conductors shall be sized as shown on the drawings.

c. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of 10 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.8.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.8.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.8.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.8.5 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.8.6 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

3.9 FIELD TESTING

3.9.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.9.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.9.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Multiple rod electrodes - 25 ohms.

c. Ground mat - 25 ohms.

3.9.4 Ground-Mat Connection Inspection

All below-grade ground-mat connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 48 hours before the site is ready for inspection.

3.9.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.9.6 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual and electrical operation of the breaker.

3.9.7 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE ANSI/IEEE C57.13.

3.9.8 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the

installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Secondary unit substation

b. Pad-mounted transformers

c. Panelboards

d. Switchboards

e. Metal-enclosed switchgear

f. Busways

g. Switches

3.9.9 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph, "SUBMITTALS."

3.10 MANUFACTURER'S FIELD SERVICE

3.10.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the

course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.10.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.11 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16403

MOTOR CONTROL CENTERS, SWITCHBOARDS AND PANELBOARDS
08/95

PART 1 GENERAL

Special Requirements.

The electrical equipment will be installed in an outdoor pumping station subject to 100 percent humidity and temperature variations between -25F and 120F. taking into account heating effects from solar radiation. The equipment may stand idle for long periods in a highly corrosive atmosphere. All equipment shall be so constructed not to cause injurious affected by the above conditions. Electric cabinets shall be protected by thermostatically controlled heaters.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 187	(1994) Copper Bar, Bus Bar, Rod and Shapes
ASTM B 317	(1992a) Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Shapes for Electrical Purposes (Bus Conductor)

ASME INTERNATIONAL (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C12.1	(1988) Code for Electricity Metering
IEEE C12.4	(1984; R 1990) Mechanical Demand Registers
IEEE C12.10	(1987) Electromechanical Watthour Meters
IEEE C12.11	(1987) Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV (0.6 kV NSV Through 69 kV NSV)
IEEE C57.13	(1993) Instrument Transformers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA PB 1	(1990) Panelboards
NEMA ST 1	(1988) Specialty Transformers (Except General Purpose Type)
NEMA ST 20	(1992) Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(1991; Rev thru Jan 1995) Rubber-Insulated Wires and Cables
UL 50	(1992) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru May 1994) Panelboards
UL 489	(1991; Rev thru Dec 1994) Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 845	(1995) Motor Control Centers
UL 1063	(1993; Rev thru Oct 1994) Machine-Tool Wires and Cables

1.2 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare

parts listed in the Schedule and shown on the drawings.

1.2.1 Rules

The equipment shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. The contractor shall immediately notify the Contracting Officer of any requirements of the specifications or contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

1.2.2 Coordination

The general arrangement of the motor control centers, switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Contracting Officer. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory. The motor control centers and switchboards may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

1.2.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the Contracting Officer, complete specifications for the materials which he proposes to use.

1.2.4 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum approximately 4 millimeters (1/8 inch) thick, engraved to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 15 millimeters (1/2 inch) high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

a. Motor Control Centers

b. Individual items of equipment mounted in the Motor Control Centers

d. Individually-mounted circuit breakers in Switchboard

f. Panelboards

g. Individually-mounted circuit breakers in Panelboard

Equipment of the withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation. Equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection. Submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA-RE.

The Contractor shall within 30 calendar days after date of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Six (6) sets of characteristic curves of the individual breaker trip element shall be submitted.

SD-04 Drawings

Outline Drawings; GA-RE.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

Motor Control Center; GA-RE.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. The NEMA Class II motor control center drawings shall include a connection diagram with wire designations and schematic diagrams to illustrate operation of associated motor unit controls. An individual

wiring diagram for each motor control center shall be submitted. Wiring diagrams shall be in a form showing physical arrangement of the control center with interconnecting wiring shown by lines or by terminal designations (wireless). A single-line diagram, equipment list and nameplate schedule shall be provided for each motor control center.

Panelboards; GA-RE.

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each switchboard and panelboard.

SD-08 Statements

Factory Tests; FIO-RE.

The Contractor shall submit, within a minimum of 14 days prior to the proposed date of tests, six (6) copies of manufacturer's routine factory test procedures and production line tests for all motor control centers and switchboards.

SD-09 Reports

Factory Tests; FIO-RE.

The Contractor shall submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Report shall be signed and dated by the Contractor's and Contracting Officer's Representatives.

SD-13 Certificates

Motor Control Center; FIO-RE.

The contractor shall submit certification of factory test reports. Certification shall be signed by official authorized to certify on behalf of the manufacturer, attesting that the motor control center meets the specified requirements. The statement must be dated after the award of this contract, must state the Contractors name and address, must name the project and location, and must list the specific requirements which are being certified.

1.4 DELIVERY, STORAGE, AND HANDLING

The equipment shall be shipped as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These

devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. All spare parts and accessories shall be carefully packaged and clearly marked.

1.5 MAINTENANCE

1.5.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus shall be furnished by the Contractor.

1.5.2 Spare Parts

Spare parts shall be furnished as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

a. 2 - Fuses of each type and size.

b. 1 - Circuit breaker auxiliary switch.

c. 2 - Operating coils for each size ac contactor.

d. 1 - Operating coil for each size dc contactor.

e. 2 - Complete sets of 3-pole stationary and moving contact assemblies for each size ac contactor.

f. 1 - Complete set of 2-pole stationary and moving contact assemblies for each size dc contactor.

g. 3 - Contactor overload relays of each type and rating, each relay with a complete set of contact blocks.

h. 1 - spare set of heater elements for each heater rating provided.

i. 2 - Indicating lamp assemblies of each type.

j. 1 - Control transformer of each type and rating.

k. 1 - Control relay of each type and rating.

l. 1 - Contactor auxiliary contact of each type.

m. 4 - One quart containers of finish paint for indoor equipment.

n. 2 - One quart containers of the paint used for the exterior surfaces of outdoor equipment.

o. 4 - Keys for motor control center door lock.

1.6 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped withapproved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Contracting Officer, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

2.2.2 480-Volt AC Circuits

Circuit breakers for 480-volt ac circuits shall be rated 600 volts ac, and shall have an UL listed minimum interrupting capacity of 42,000 symmetrical amperes at 600 volts ac.

2.2.3 120/240-Volt AC Circuits

Circuit breakers for 120-volt ac circuits shall be rated not less than 120/240 or 240 volts ac, and shall have a UL listed minimum interrupting capacity of 10,000 symmetrical amperes.

2.3 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 12 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4 TERMINAL BLOCKS

Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.4.1 Types of Terminal Blocks

2.4.1.1 Short-Circuiting Type

Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph, "CONTROL CIRCUIT TERMINAL BLOCKS" above.

2.4.1.2 Load Type

Load terminal blocks rated not less than 600 volts and of adequate capacity

shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.4.2 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

2.5 SPACE HEATERS

Space heaters shall be provided where indicated on the drawings and shall be controlled using an adjustable 10 to 35 degree C (50 to 90 degree F) thermostat, magnetic contactor, and a molded-case circuit breaker and a 480-120 volt single-phase transformer. The space heaters shall be 250-watt, 240 volt strip elements operated at 120 volts and shall be wired as shown on the drawings.. The contactors shall be open type, electrically-held, rated 30 amperes, 2-pole, with 120-volt ac coils.

2.6 MOTOR CONTROL CENTERS

Each motor control center shall be designed for operation on 480-volts ac, 3-phase, 60-Hz system, and the equipment shall conform to all the applicable requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4and NEMA ICS 6. Vertical sections and individual units shall be listed and labeled under UL 845 where ever possible. In lieu of the UL listing, certification from any nationally recognized, adequately equipped, testing agency that the individual units and vertical sections have been tested and conform to the UL requirements of that agency will be acceptable when approved by the Contracting Officer. The motor control center shall be NEMA Class II, Type B, motor control centers in accordance with NEMA ICS 2.

2.6.1 Enclosures

Each motor control center shall consist of the required number of vertical sections of 2250 millimeters (90 inches) nominal height, bolted together, with steel channel sills and suitable for mounting against a wall. Vertical section shall be 510 millimeters (20 inches) deep and buses, control wiring, control transformers, small power transformers, terminal blocks, line terminals, cable supports, and clamps shall be accessible from the front. Enclosure shall be NEMA Type 3R. The control centers shall be fabricated from smooth select steel sheets shaped and reinforced to form rigid free-standing structures. Metal thickness for enclosures shall be not less than specified in NEMA ICS 6 without exception. Vertical edges of sections exposed to view shall be so fabricated and bolted that the joints will not pass a 1.6 millimeter (1/16 inch) gage. Each structure shall be designed for addition of future sections required. Individual compartments shall be isolated from adjacent compartments.

2.6.1.1 Unit Compartments

Each operating unit shall contain equipment as shown on the drawings, mounted in an individual cell. The unit assembly, except main circuit breakers, panelboards and auxiliary control devices, shall be drawout type removed from the front, without rear access or disturbing other units in the control center assembly. All drawout type unit assemblies shall have positive guide rail system to ensure alignment of connection to vertical bus. Units shall be mechanically interlocked with the door to prevent removal while in the energized position. Each removable unit shall have provision for padlocking in a position in which it is disconnected from the vertical bus although not removed from the stationary structure. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Bus closing plugs shall be provided for all unused openings in vertical bus barriers.

2.6.1.2 Motor Control Center Doors and Covers

Each unit compartment, including blank compartments for future use, shall be provided with either a flange-formed or a rolled-edge door. Each door shall be mounted on fully-concealed or continuous full-length piano-type hinges and shall be provided with positive fasteners. Door sag shall be prevented by proper alignment of hinges made of sufficiently strong material. The door fastenings shall be so interlocked to prevent opening when the equipment is energized. The external operating handle shall clearly indicate whether the equipment is in an "ON", "OFF" or "TRIPPED" position.

2.6.1.3 Sills

Channel iron foundations, complete with bolts and drilled holes for grouting and anchoring to the floor, shall be furnished for the complete length (front and rear) of each motor control center assembly. The channels shall be designed for flat mounting and maximum channel depth shall be 60 millimeters (2-1/2 inches). Additional channel or substantial metal trim shall be provided flush with the end panels to completely

enclose the bases across the ends of the equipment assemblies.

2.6.1.4 NEMA 3R Enclosures

The motor control center shall be non-walk in NEMA Type 3R rainproof enclosure as shown on the drawings. The outside enclosure shall consist of smooth select steel sheets on a structural steel frame. Full-length single or double doors shall be provided with top and bottom bolts and a center latch operated by means of a keyed handle. Steel sheets and doors shall be not less than 3.5 millimeters (No. 10 gage) thick and doors shall have bent angle or channel edges with all corner seams welded and ground smooth. The motor control center within the enclosure shall be assembled with adequate gaskets and structure to assure a measure of vandal resistance. Ventilating openings and an effective insulating air space of approximately 50 millimeters (2 inches) shall be provided below the roof of the structure which shall slope from front to back for adequate drainage. The outside edges of the control center base shall permit easy sealing at the concrete surface with mastic compound. All 120 volt circuits shall be wired to the 120-volt ac panelboard located in the control center, and external wiring shall be run in rigid galvanized steel conduit.

2.6.1.5 Shutters

Drawout units shall have shutters which close when the unit is withdrawn to isolate the vertical bus.

2.6.1.6 Thermostatically Controlled Strip Heaters

Thermostatically controlled strip heaters as specified in paragraph, "SPACE HEATERS" shall be provided where indicated.

2.6.2 Buses

All buses shall be of copper and shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187 . All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. The bus ratings shall be based on a 65 degree Celsius maximum temperature rise in accordance with UL 845 requirements. Bus shall have a short-circuit current rating of not less than 42,000 RMS symmetrical amperes. All bus work shall be supported on wet process porcelain insulators, glass polyester, or suitable molded material.

2.6.2.1 Horizontal Bus

Each control center assembly shall be provided with a three-phase main horizontal bus, with a continuous current rating not less than 800 amperes, located across the top of each vertical section. The ends of horizontal buses shall be drilled for future extensions. The main horizontal bus shall be fully insulated.

2.6.2.2 Vertical Bus

Each vertical section shall be provided with a three-phase vertical bus

with a continuous current rating of 600 amperes connected to the horizontal bus by brazing, welding, or bolting. Where the incoming feeder breakers are located at the bottom of a control center, the vertical bus in that section shall be rated the same as the main horizontal bus. Vertical buses shall extend from the horizontal bus to the bottom of the lowest available unit mounting space. The vertical bus shall be isolated from wireways and equipment in compartments.

2.6.2.3 Ground Bus

A copper ground bus shall be provided full width at the bottom of the motor control center line-up. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.6.3 Reduced Voltage Starters

Autotransformers shall be rated for medium duty and have taps according to NEMA ICS 2. For thermal over load protection, the autotransformer shall have normally closed thermostat wired in series with the normally closed thermal overload contact of the starter. Initial connection shall be to the 65 percent tap. Current transformers shall provide feedback signal to regulate torque during start up and to prevent overload conditions while motor is running. Starter shall have starting current of 300 percent of full load amps for thirty seconds, bypass/isolation contactor, and three phase thermal overload relay.

2.6.4 Auxiliary Contacts

Each controller shall be provided with a minimum of three auxiliary contacts which can be easily changed from normally open to normally closed. Where indicated on the drawings, a fourth auxiliary contact and red and green indicating lights shall be provided.

2.6.5 Overload Relays

Except as otherwise indicated, each controller shall be provided three NEMA Class 20 thermal overload relays with external manual reset. Prior to shipment of the control centers, the Contracting Officer will furnish the ratings of the heater elements to be installed in the relays by the Contractor.

2.6.6 Individual Control Transformers

Where 120 volt ac control of contactors is indicated or required, individual control transformer shall be provided on the line side of the unit disconnect. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the control functions indicated. Transformers shall be installed without

primary fuses. Except as otherwise indicated on the drawings, each control transformer shall be provided with a fuse in one secondary lead and shall have the other secondary lead grounded.

2.6.7 Voltage Fault Protection(MPMD)

Where shown, starters shall be provided with protection against voltage faults, phase unbalance, phase loss, phase reversal, undervoltage and overvoltage. Upon sensing one of these faults, the protector shall de-energize the starter. The protector shall use a combination of voltage and phase-angle sensing to detect phase loss even when regenerated voltages are present. The protector shall be connected to the load side of the motor circuit disconnect. The protector shall have an adjustable line voltage trip level, adjustable trip delay, automatic reset and manual reset by an external normally closed push-button, and Double Pull Double Throw (DPDT) output contacts. Protector operation shall have repeatability of +1 percent of set point, maximum, and a dead band of 2 percent maximum. Protector shall have green indicator to show normal status and red indicator to show tripped status. Indicators will be visible through the compartment door, when LED's are used protector shall be covered with a clear unbreakable cover, when lamps are used they shall have nameplates and be grouped with other indicating lights.

2.6.8 Control Circuit Disconnects

Control circuit power shall disconnect when the unit compartment is opened.

2.6.9 Molded Case Circuit Breakers in Unit Compartments

Molded case circuit breakers for installation in unit compartments shall meet the requirements of paragraph, "MOLDED CASE CIRCUIT BREAKERS" above.

2.6.10 Panelboards for Motor Control Centers

Panelboards shall meet the requirements of paragraph, "PANELBOARDS."

2.6.11 Distribution Transformers

Dry type transformers for power and lighting loads shall be furnished with voltage and kVA ratings as indicated on the drawings. The transformers shall conform to the requirements for general-purpose transformers in NEMA ST 20. Each transformer shall be protected on the primary side with a molded case circuit breaker as indicated on the drawings. Transformer shall be incorporated into a Mini Power Center located in the Motor Control Center.

2.6.12 Ground Detector Indicator

Ground-detector indicator (GDI) shall be rated 120-volts; have three lamps, one per phase, three 480-120 volt transformers connected delta-wye, adjustable loading resistor for balancing capacitive charging current, and push-to test-switch. GDI shall provide visual indication of a single ground-fault on any phase (A, B, or C) of a three-phase, three-wire ungrounded power system. When no phase is grounded, all lamps shall glow

at partial brightness, giving long lamp life, the push-to test switch shall not affect the brightness of any lamp. When a single ground-fault occurs on any phase, the lamp that corresponds to the faulted phase shall be dark and the other two lamps shall glow at full brightness. The push-to-test switch shall cause all lamps to return to partial brightness, showing the GDI is functioning properly.

2.6.13 Wiring for Motor Control Centers

Wiring for Motor Control Center shall be NEMA Class II, Type B. All wiring shall also meet the requirements of paragraph, "WIRING" above. Heavy-duty clamp type terminals shall be provided by the Contractor for terminating all power cables entering the control centers.

2.6.13.1 Contractor's Wiring

The Contractor's wiring shall be formed into groups, suitably bound together, properly supported and run straight horizontally or vertically. There shall be no splices in the wiring. The manufacturer's standard pressure-type wire terminations for connections to internal devices will be acceptable. Terminal blocks shall be added for wiring to devices having leads instead of terminals. Ring tongue indented terminals shall be used on all wires terminated on control terminal blocks for external or interpanel connections and at shipping splits. All stud terminals shall have contact nuts and either locking nuts or lockwashers.

2.6.13.2 External Connections

Power and control cables will enter the control centers at the bottom.

2.6.13.3 Terminal Blocks

Terminal blocks shall meet the requirements of paragraph, "TERMINAL BLOCKS" above. In no case shall the terminals provided for circuit breakers or contactors accommodate less than the number or size of conductors shown on the drawings. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.6.14 Control Transformers

Control transformers for several starter units shall be mounted in a separate compartment and its primary windings shall be connected to the main bus through a molded case circuit breaker of suitable rating. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the control functions indicated and an additional 10 percent capacity. Transformers shall be installed without primary fuses. Except as otherwise indicated on the drawings, each unit compartment shall provide a fuse for control power in one secondary lead and shall have the other secondary lead grounded. The unit disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.

2.6.15 Accessories and Control Devices

Control accessories shall be provided, and shall be suitable for mounting on the front of, or inside, the control centers as indicated on the drawings. Control accessories shall meet the applicable requirements of NEMA ICS 2. Relays and other equipment shall be so mounted that mechanical vibration will not cause false operation.

2.6.15.1 Control Stations

Push-button stations and selector switches shall conform to NEMA ICS 2, shall be of the heavy-duty, oil-tight type, rated 600 volts ac, and have a contact rating designation of A600. Switches shall be provided with escutcheon plates clearly marked to show operating positions. Sufficient contact blocks shall be provided to make up the electrically separate contacts required for lead-lag selector switches.

2.6.15.2 LED Indicating Lights

Red, green and white LED's shall be furnished where shown on the drawings, indicating contact "open" and "closed" position. The LED's shall be accessible and replaceable from the front of the control center through a finished opening in the compartment door. The LED assemblies shall be of the heavy duty oil-tight, water-tight, and dust-tight type.

2.6.15.3 Control Relays

Control relays shall be of the electrically operated, magnetically held, self-reset, open type, suitable for mounting inside the starter compartments, and shall be 120-volt ac. Contacts shall be as indicated on the drawings and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

2.6.15.4 Timing Relays

Timers shall be pneumatic type. They shall be suitable for mounting inside the control center and shall be rated 120 volts ac, 60 Hz. Instantaneous and time delay contacts shall be provided as indicated on the drawings, and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2. Means shall be provided for manual adjustment over a range as indicated on the drawings.

2.6.15.5 Elapsed-Time Meters

Hour-indicating time meters shall have 6- digit registers with counter numbers at least 7 millimeters (1/4 inch) high. White numbers on black backgrounds shall provide hour indication with the last digit in contrasting colors to indicate tenths of an hour. The enclosure shall be 90 millimeters (3-1/2 inches) square and dust resistant. Operating voltage shall be 120 volts ac. They shall be of the nonreset type.

2.6.16 Feeder Tap Units

Feeder tap units shall be provided as indicated on the drawings.

2.6.17 Metering Section

Metering section shall be provided with instruments as indicated on the drawings.

2.6.17.1 Instrument Transformers

All transformers used for metering shall meet the requirements of IEEE C12.11 and IEEE C57.13. Voltage transformers shall be protected with removable primary and secondary fuses. Fuses shall be installed in each ungrounded lead and located adjacent to the transformers in an easily accessible place. If cable connections to current transformer primary are required, terminals of an approved solderless type and proper size shall be furnished. If current transformers are connected to buses, proper connections shall be furnished, complete with bolts, nuts, washers and other accessories.

2.6.17.2 Ammeters

Switchboard type ammeter shall be provided where indicated on the drawings. Ammeter, range 0 to load amperes required for the pump station, complete with selector switch having off position and positions to read each phase current. Meters shall be long scale 175 millimeters (6.8 inches), semiflush rectangular, indicating type mounted at eye level.

2.6.17.3 Voltmeters

Switchboard type voltmeter shall be provided where indicated on the drawings. Voltmeter, range 0 to 600 volts, complete with selector switch having off position and positions to read each phase to phase voltage. Meters shall be long scale 175 millimeters (6.8 inches), semiflush rectangular, indicating type mounted at eye level.

2.6.17.4 Watthour Meters

Watthour meters shall conform to IEEE C12.1 and IEEE C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15-minute, cumulative form, demand register meeting IEEE C12.4 and provided with not less than two and one-half stators. Watthour demand meters shall have factory installed electronic pulse initiators meeting the requirements of IEEE C12.1.

2.6.17.5 Switches

All metering switches shall be of the rotary switchboard type with handles on the front and operating contact mechanisms on the rear of the panels. Control switches shall be suitable for operation on 600-volt AC or 250-volt DC circuits. All such switches shall be capable of satisfactorily withstanding a life test of at least 10,000 operations with rated current flowing in the switch contacts. Selector switches shall be maintained-contact type with the required number of positions, and shall have round notched, or knurled handles. Ammeter switches shall not open

the secondary circuits of current transformers at any time. Instrument switches for potential selection shall have oval handles.

2.6.18 Power-Factor-Correction Capacitors

Three-phase, delta-connected capacitors for power factor improvement shall be rated 480 volts, 60 Hz. The KVAR capacity of the capacitors shall not be greater than that recommended by the motor manufacturer or if no such recommendation exists, that value which gives with a lagging power factor at no-load. The KVAR capacity shall not cause any system mafuctions or delays associated with its use. If size permits, the capacitors shall be mounted in an adjacent compartment, or otherwise shall be mounted separately and connected to the motor at the motor terminal box. For reduced voltage starters, the capacitors shall be separately switched with a time-delayed contactor rated according to NEMA ICS 2 for capacitor switching.

2.6.19 Space for Mounting PLC's

Space for mounting of Programmable Logic Controllers (PLC's) shall be provided as indicated on the drawings.

2.7 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboard shall be incorporated into MCC as indicated on the plans. Panelboards shall be fully rated for a short-circuit current of 10,000 symmetrical amperes RMS ac.

2.7.1 Enclosure

Panelboard shall be incorporated into Mini Power Center installed in the Motor Control Center.

2.7.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper and shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187. The sizes of buses and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

2.7.3 Components

Each branch circuit, and the main buses where so specified or shown on the

drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph, "MOLDED CASE CIRCUIT BREAKERS." Circuit breakers of the same frame size and rating shall be interchangeable.

2.8 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Grey. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph, "SPARE PARTS."

2.9 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Contracting Officer unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Contracting Officer to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Contracting Officer. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Contracting Officer. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

2.9.1 Motor Control Centers Tests

2.9.1.1 Dielectric Tests

Each motor control center shall be completely assembled and given dielectric tests in accordance with NEMA ICS 1.

2.9.1.2 Operational Tests

The correctness of operation of each air circuit breaker or motor circuit protector and magnetic contactor and of all control devices, accessories and indicating lamps, shall be checked. These checks shall be made at rated voltage with power supplies to the main buses. All magnetic contactors shall also be checked for proper operation with power at 90 percent of rated voltage.

2.9.1.3 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the contractor may submit design tests demonstrating that satisfactory short-circuit tests, as specified in NEMA ICS 2, have been made on a motor control center of similar type of construction and having the same available short circuit current at the motor terminals, including any motor contributions, as the motor control centers specified to be furnished under these specifications.

2.9.2 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 16415

ELECTRICAL WORK GENERAL
08/96

PART 1 GENERAL

Special Requirements.

The electrical equipment shall be installed in an outdoor pumping station subject to 100 percent humidity and temperature variations between -25 F and 120 F. taking into account heating effects from solar radiation. The equipment may stand idle for long periods in a highly corrosive atmosphere. All equipment shall be so constructed not to cause injurious affected by the above conditions. Electric cabinets shall be protected by thermostatically controlled heaters.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C37.16	(1997) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C57.12.50	(1981; R 1989) Ventilated Dry-type Distribution Transformers 1 to 500 kVA, Single-Phase; and 15 to 500 kVA, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts

ANSI C57.12.70	(1978; R 1993) Terminal Markings and Connections for Distribution and Power Transformers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(1992; R 1997) Laminated Thermosetting Materials
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Industrial, Scientific, and Medical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.80	(1996) Terminology for Power and Distribution Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

(Part 1)

IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3; Rev 4) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1995) Power Switching Equipment
NEMA ST 20	(1992) Dry-Type Transformers for General Applications

NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 101	(1997; Errata 97-1; TIA 97-1) Life Safety Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 5	(1996) Surface Metal Raceways and Fittings
UL 6	(1997) Rigid Metal Conduit
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches
UL 44	(1997; Rev Mar 1999) Thermoset-Insulated Wires and Cables
UL 50	(1995; Rev thru Oct 1997) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru Nov 1995) Panelboards
UL 83	(1998) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R thru Jun 1998) Enclosed and Dead-Front Switches
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and

Bonding Equipment

UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Sep 1998) Attachment Plugs and Receptacles
UL 506	(1994; Rev Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Jul 1998) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru Jul 1998) Cord Sets and Power-Supply Cords
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables

UL 869A	(1998) Reference Standard for Service Equipment
UL 943	(1993; Rev thru May 1998)Ground-Fault Circuit-Interrupters
UL 1004	(1994; Rev thru Dec 1997) Electric Motors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures
UL Elec Const Dir	(1998) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

Wiring and equipment in locations indicated shall be of the classes, groups, divisions, and suitable for the operating temperature; as indicated.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish six sets of as-built drawings to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section, SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Catalog; GA-RE.

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; GA-RE.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; GA-RE.

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

SD-04 Drawings

Interior Electrical Equipment; GA-RE.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the

installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

As-Built Drawings; GA-RE.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract

drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

SD-08 Statements

Onsite Test; GA-RE.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-13 Certificates

Materials and Equipment; GA-RE.

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

1.5 SEISMIC REQUIREMENTS

Seismic details shall be as indicated

1.6 MEASUREMENT AND PAYMENT

No separate measurement or payment will be made for work covered under this Section and all costs shall be included in the contract unit or lump sum price for the item of work to which the materials and work is incidental.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

.2.1.1 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.2 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.3 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

..2.2 CONDUIT AND TUBING

2.2.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.2.2 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.2.3 Intermediate Metal Conduit

UL 1242.

2.2.4 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.2.5 Rigid Metal Conduit

UL 6.

2.2.6 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

2.2.7 Surface Metal Electrical Raceways and Fittings

UL 5.

2.3 CONDUIT AND DEVICE BOXES AND FITTINGS

2.3.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.3.2 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.3.3 Fittings for Conduit and Outlet Boxes

UL 514B.

2.3.4 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.4 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.5 CONNECTORS, WIRE PRESSURE

2.5.1 For Use With Copper Conductors

UL 486A.

2.6 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.6.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 15 feet in length of the sectional type driven full length into the earth.

2.6.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.7 ENCLOSURES

NEMA ICS 6 unless otherwise specified.

2.7.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.7.2 Circuit Breaker Enclosures

UL 489.

2.8 LIGHTING FIXTURES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lighting equipment installed in classified hazardous locations shall conform to UL 844. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.8.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992.

c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -20 degrees F. Metal halide lamps, unless

otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355,ANSI C78.1375, and ANSI C78.1376.

2.8.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

2.8.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 0.125 inches. Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type.

c. High intensity discharge fixture shall comply with UL 1572. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.

2.9 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.10 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.11 RECEPTACLES

2.11.1 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 20-Ampere, 125 Volt

NEMA type L5-15R, 20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

2.12 Service Entrance Equipment

UL 869A.

2.13 SPLICE, CONDUCTOR

UL 486C.

2.14 SNAP SWITCHES

UL 20.

2.15 TAPES

2.15.1 Plastic Tape

UL 510.

2.15.2 Rubber Tape

UL 510.

2.16 WATTHOUR METERS, UTILITY REVENUE

Watthour meters shall conform to ANSI C12.1 and ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket-mounted outdoor type having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of one pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.17 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of

wiring devices.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable

expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding. Wiring installed in underfloor raceway system shall be suitable for installation in wet locations.

3.2.1.1 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.2 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.3 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.4 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.5 Supports

Metallic conduits and tubing,and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam

clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.6 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.7 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 10 feet.

3.2.2 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.2.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors

shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.2.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.2.3 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

b. Greater Than 600 Volt: Cable splices shall be made in accordance with the cable manufacturer's recommendations and Section, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.2.4 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).
120/240-volt, 1-phase: Black and red.

b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a

minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.

c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 3R or as shown. Boxes in other locations shall be sheet steel except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit and tubing or nonmetallic sheathed cable system, when permitted by NFPA 70. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon

anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.4 RECEPTACLES

3.4.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be gray, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. O Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.4.2 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.4.2.1 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use. Assemblies which utilize a self-sealing boot or gasket to maintain wet location rating shall be furnished with a compatible plug at each receptacle location and a sign notifying the user that only plugs intended for use with the sealing boot shall be connected during wet conditions.

3.5 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits . Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.6 AERIAL SERVICE

Services shall conform to the requirements of Section, ELECTRICAL DISTRIBUTION SYSTEM, AERIAL, IEEE C2, and NFPA 70. The service drop conductors shall be continuous from the point of connection on the last pole to the service mast or structural support, connected to the service entrance conductors, and shall be routed to a weatherhead, or weatherproof conduit fitting, before entry into an enclosing conduit. A drip loop shall be formed in each service conductor below the entrance to the weatherhead or the weatherproof conduit fitting. The weatherhead or weatherproof service entrance conduit fitting shall be securely fastened to a rigid galvanized steel (RGS) conduit that shall be terminated in the meter enclosure which penetrates the exterior wall. Service entrance conductors shall be routed in intermediate metal conduit (IMC) in the exterior wall, or in the interior of the building or facility that contains the meter enclosure. Aerial service drop conductors will be extended to building service entrance and terminated.

3.7 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.7.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.7.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved.

3.7.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.7.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.7.3.1 Programable Logic Controller

A programable logic controller (PLC) shall be provided to control pumps when system is in the auto mode. The PLC shall be self contained and operate on 120 VAC. The PLC shall be housed in a NEMA 4 enclosure. The enclosure shall be equipped with a strip heater that will allow PLC to operate adequately in the temperatures specified. The technical requirements are as follows:

1.	Temperature Range	-25 to 120 degrees F
2.	Humidity	5% to 95%
3.	Throughput	1.5 ms for 500 instruction program
4.	Memory	1K EEPROM
5.	Analog Inputs	2
6.	Digital Inputs	8
7.	Digital Outputs	16
8.	Connectivity	RS 232, DH 485

The PLC shall be Allen Bradley Micrologix 1000 or approved equal.

3.7.3.2 Level Indication and Display Module

Provide a level indication display with 0.6 inch high LED numerals. Display shall be housed in NEMA 4 enclosure. Display shall be capable of providing level indication from each pressure transducer. Pressure transducer input shall be 4-20 ma. Display will also have two 4-20 ma outputs that will be routed to the PLC. The enclosure shall be equiped with a strip heater that will allow operation in temperatures from -25 to 110 degrees F. and from 5% to 95% humidity. Power provided to the unit shall be 120 VAC. Power supply for pressure transducers shall be internal to the unit.

The level indication and display module shall be Druck DPI 280 or approved equal.

3.7.3.3 Pressure Transducer Level Indicators

Provide presure transducers installed in a 2-ich galvanized steel pipe as indicated on the drawings. One transducer acts as the primary and the second acts as the secondary and will be used for comparisions to ensure valid measurements are being made. The transducer will shall meet the

following requirements:

1.	Power	24VDC (Provided by Level Indication and Display Module)
2.	Output	4-20ma DC
3.	Accuracy	+/- .25%
4.	Temperature Range	0 to 100 F
5.	Pressure Range	0 to 15 PSI (33 feet of water)

Each transducer shall be installed as indicated on the plans. They shall be capable of withstanding at least two times full scale pressure without damage or loss of calibration. Transducer shall be construted of Titanium materials and suitable for this application.

The pressure transducers shall be Druck PTX 1230 or approved equal.

3.8 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.9 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section, PAINTING: HYDRAULIC STRUCTURES.

3.10 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 20 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.10.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.10.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms max..
b. Grounding System -5 ohms max.

3.10.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 24 hours before the site is ready for inspection.

3.10.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.10.4.1 Medium Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

c. DC high-potential test.

3.10.5 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.11 FIELD SERVICE

3.11.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training shall be submitted.

3.11.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.12 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --