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1. AGENCY USE ONLY (Leave blank) 2. REPORT DATE 05/00/90 3. REPORT TYPE AND DATES COVERED

4. **ROCKY MOUNTAIN ARSENAL, SANITARY SEWER INTERIM RESPONSE ACTION, FINAL IMPLEMENTATION PLAN** 5. FUNDING NUMBERS

6. AUTHOR(S) DAAA15 88 R 0023

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) ROY F. WESTON, INC. 8. PERFORMING ORGANIZATION REPORT NUMBER 90232R01

9. SPONSORING MONITORING AGENCY NAME(S) AND ADDRESS(ES) ROCKY MOUNTAIN ARSENAL (CO.). PHRMA 10. SPONSORING MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

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12a. DISTRIBUTION AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED 12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 300 words)
THE PRIMARY OBJECTIVE OF THIS INTERIM RESPONSE ACTION IS TO PREVENT THE POTENTIAL SPREAD OF CONTAMINATION VIA THE SANITARY SEWER SYSTEM. THE IRA WILL CONSIST OF 1) CONSTRUCTION OF A NEW SANITARY SEWER AND 2) SEALING OF THE EXISTING SEWER IN THE NORTH PLANTS AND SOUTH PLANTS AREAS ALONG WITH THE INTERCEPTOR LINE IN SECTION 36.
SECTIONS AND APPENDICES OF THIS FINAL IMPLEMENTATION PLAN INCLUDE:
1. BACKGROUND AND OVERVIEW OF COURSE OF ACTION
2. PROCEDURES FOR SEALING THE EXISTING SEWER LINES WITH CONCRETE
3. SCHEDULE OF CLOSURE EVENTS
4. HEALTH AND SAFETY PLAN FOR CLOSURE OF EXISTING LINES
5. SPECIFICATIONS AND PLANS FOR THE NEW SANITARY SEWER
6. CHEMICAL, PHYSICAL, AND BIOLOGICAL PROPERTIES OF CONTAMINANTS
7. REQUEST FOR PROPOSALS.

14. SUBJECT TERMS COST, SCHEDULE, HEALTH, SAFETY, SPECIFICATION, IRA J, CONSTRUCTION 15. NUMBER OF PAGES 16. PRICE CODE

17. SECURITY CLASSIFICATION UNCLASSIFIED 18. SECURITY CLASSIFICATION OF THIS PAGE 19. SECURITY CLASSIFICATION OF ABSTRACT 20. LIMITATION OF ABSTRACT

ROCKY MOUNTAIN ARSENAL
SANITARY SEWER INTERIM RESPONSE ACTION
CONSTRUCTION DOCUMENTS FOR NEW SANITARY SEWER
CONSTRUCTION
VOLUME II

Document Control Number 5300-01-03-AABA

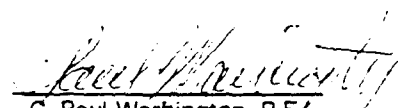
May 1990
Contract No. DAAA15-88-R-0023

Prepared for:

U.S. Army Program Manager
Rocky Mountain Arsenal

Prepared by:

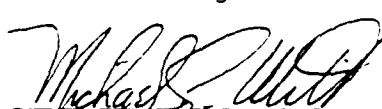
Roy F. Weston, Inc.
215 Union Boulevard
Suite 550
Lakewood, Colorado 80228


C. Paul Warbington, P.E.
Task Manager

93-29682



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Micheal E. Witt, Ph.D.
Project Director

THE USE OF TRADE NAMES IN THIS REPORT DOES NOT CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE USE OF SUCH COMMERCIAL PRODUCTS. THIS REPORT MAY NOT BE CITED FOR PURPOSES OF ADVERTISEMENT.

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Solicitation No.

DEPARTMENT OF THE ARMY
OMAHA DISTRICT, CORPS OF ENGINEERS
215 NORTH 17TH STREET
OMAHA, NEBRASKA 68102-4978

DATE: _____

SUBJECT: INVITATION FOR BIDS - CONSTRUCTION CONTRACT

TO: All Prospective Bidders and Others Concerned

NAME AND LOCATION OF PROJECT: BY (Issuing Office):

Rocky Mountain Arsenal
Commerce City, Colorado

U.S. Army Engineer District, Omaha
1612 U.S. Post Office and Courthouse
215 North 17th Street
Omaha, Nebraska 68102-4978
68102-4978

SEALED BIDS (one copy only) for the work described herein will be received until _____ p.m., local time at the place of bid opening _____ in the office of the Commander:

U.S. Army Engineer District, Omaha
1612 U.S. Post Office and Courthouse
215 North 17th Street
Omaha, Nebraska 68102-4978

NOTE: Hand-carried bids shall be delivered to Room _____

and at that time PUBLICLY opened.

Basis for Award.

AUTHORITY: The work provided for herein is authorized:

DESCRIPTION OF WORK: The work consists of furnishing all plant, labor, materials, and equipment and performing all work for the complete installations and start-up of a force main sewer system at the referenced site.

The above general outline does not limit the work to be less than all that required under the plans and specifications.

DTIC QUALITY INSPECTION

Accession For
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BIDDING INFORMATION

1. **EXPLANATION TO PROSPECTIVE BIDDERS.** Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders. (FAR 52.214-6.)
2. **SOLICITATION DEFINITIONS - SEALED BIDDING.** "Offer" means "bid" in sealed bidding. "Solicitation" means an invitation for bids in sealed bidding. "Government" means United States Government. (FAR 52.214-1.)
3. **SUBMISSION OF BIDS**
 - 3.1 Bids and bid modifications shall be submitted in sealed envelopes or packages (1) addressed to the office specified in the solicitation and (2) showing the time specified for receipt, the solicitation number, and the name and address of the bidder.
 - 3.2 Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice, if such notice is received by the time specified for receipt of bids. (FAR 52.214-5.)
4. **PREPARATION OF BIDS - CONSTRUCTION**
 - 4.1 Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a bid must initial each erasure or change appearing on any bid form.
 - 4.2 This solicitation requires bidding on all items. Failure to provide the contract price and evaluation factors required by Item No. 1 in the BIDDING SCHEDULE will cause the bid to be rejected as nonresponsive.
5. **FALSE STATEMENTS IN BIDS** Bidders must provide full, accurate, and complete information as required by this solicitation and its attachments. The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001. (FAR 52.214-4.)
6. **LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS**
 - 6.1 Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered, unless it is received before award is made and it:
 - (1) was sent by registered or certified mail not later than the fifth calendar day before the date specified for receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th); or
 - (2) was sent by mail or was a telegraphic bid if authorized, and it is determined by the Government that the late receipt was due solely to mishandling by the Government after receipt at the Government installation.
 - 6.2 Any modification or withdrawal of a bid is subject to the same conditions as in paragraph 6.1 above.

- 6.3 The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark on the wrapper or on the original receipt from the U.S. or Canadian Postal Service. If neither postmark shows a legible date, the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression exclusive of a postage meter machine impression that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerks to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.
- 6.4 The only acceptable evidence to establish the time of receipt at the Government installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.
- 6.5 Notwithstanding paragraph 6.1 above, a late modification of an otherwise successful bid that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.
- 6.6 A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identity of the person requesting withdrawal is established and that person signs a receipt for the bid. (FAR 52.214-7.)
7. **INFORMATION FOR MODIFYING BIDS.** Bids which have been mailed to the designated bid receiving office may be modified or withdrawn by mail, mailgram, or telecopier (FAX).
- 7.1 **OMAHA DISTRICT OFFICE.** Telecopier modifications to or withdrawals of previously mailed bids may be transmitted to the Omaha District (OD) Message Center.
- 7.1.1 For modifications or withdrawals by telecopier, the OD Message Center Telecopier access phone number is 402-221-3029 and 3030. Telecopier transmittals must be compatible with Xerox Telecopier. Telephone modifications or withdrawals, other than telecopier, will not be accepted.
- 7.1.2 Any questions regarding these procedures should be directed to the OD Message Center at 402-221-3022. This number should also be used to verify the receipt of messages.
- 7.2 **OTHER LOCATIONS.** Modifications to or withdrawals of previously submitted bids should be transmitted to the place of bid opening shown on page IB-1.
8. **BID GUARANTEE**
- 8.1 Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.
- 8.2 The bidder shall furnish a bid guarantee in the form of a firm commitment, such as a bid bond, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.
- 8.3 If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or give performance and payment bonds as required by the solicitation within the time specified, the Contracting Officer may terminate the contract for default.

- 8.4 Unless otherwise specified in the bid, the bidder will (1) allow 60 days for acceptance of its bid, and (2) give performance and payment bonds within 10 days after receipt of the forms by the bidder.
- 8.5 In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference. (FAR 52.228-1.)
- 8.6 Each bidder shall submit with his bid a bid bond (Standard Form 24) or other security in the amount of twenty percent (20%) of the total bid price including any additives or Three Million Dollars (\$3,000,000), whichever is lesser. The bid bond penalty may be expressed in terms of a percentage of the total bid price or expressed in dollars and cents.
9. **PERFORMANCE AND PAYMENT BONDS.** Within 10 days after the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to the Government, furnished; namely a performance bond (Standard Form 25) and a payment bond (Standard Form 25A). Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of the contract performance. The cost of premiums for performance and payment bonds shall be included in the bid price. The penal sums of such bonds will be as follows:
- 9.1 **PERFORMANCE BOND.** The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.
- 9.2 **PAYMENT BOND.**
- 9.2.1 When the contract price is \$1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.
- 9.2.2 When the contract price is in excess of \$1,000,000 but not more than \$5,000,000, the penal sum shall be forty percent (40%) of the contract price.
- 9.2.3 When the contract price is more than \$5,000,000, the penal sum shall be \$2,500,000.
- 9A **INDIVIDUAL SURETIES.** Federal Acquisition Regulation Section 28.202-2 provides that individual sureties are acceptable for all types of bonds except position schedule bonds. In addition to the bonds, individual sureties shall execute and provide to the Contracting Officer STANDARD FORM 28, AFFIDAVIT OF SURETY. Similarly, bidders shall submit, with their bonds, good and sufficient evidence as to the validity of the information provided on STANDARD FORM 28 including, but not limited to, proof of ownership and proof of the net value of the assets listed. This information shall also be provided for all other individual surety bonds submitted or to be submitted in connection with this procurement, when requested. Additionally, prior to award, individual sureties providing Performance and/or Payment bonds shall execute, record with the proper authorities and provide to the Contracting Officer an agreement not to encumber the assets listed on STANDARD FORM 28 during the pendency of the contract so as to render their net value to be less than the penal sum of the bond.
10. **CONTRACT AWARD - SEALED BIDDING - CONSTRUCTION.**
- 10.1 The Government will evaluate bids in response to this solicitation and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering price and the evaluation factors specified in the Bidding Schedule.
- 10.2 The Government may reject any or all bids, and waive informalities or minor irregularities in bids received.

- 10.3 The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation of the bid.
11. **STANDARD INDUSTRIAL CLASSIFICATION (SIC).** In accordance with Division C of the SIC Manual, the work in this solicitation is assigned classification code 1623.
- 11A. **SMALL BUSINESS SIZE STANDARD.** This solicitation is not limited to small business concerns, but, for definition purposes, a concern is small if its average annual receipts for its preceding 3 fiscal years did not exceed \$17 million. (based on FAR 19.102-1.)
12. **ADDITIONAL DRAWINGS AND SPECIFICATIONS.** Sets of drawings, reduced to half-size, and of specifications will be furnished upon receipt of payment of \$5.00 per set. The drawings need not be returned but in the event no award is made, the payment will be refunded upon request. Additional copies of the specifications alone will be furnished an applicant at the rate of \$3.00 per copy. Payment will be made by check or money order payable to "Omaha District, Corps of Engineers" and delivered to the Commander, U.S. Army Engineer District, Corps of Engineers, 1612 U.S. Post Office and Courthouse, 215 N. 17th Street, Omaha, Nebraska 68102-4978, ATTN: Finance and Accounting Office.
13. **AMENDMENTS.**
- 13.1 **CHANGES PRIOR TO OPENING BIDS.** The right is reserved, as the interest of the Government may require, to revise the specifications and/or drawings prior to the date set for opening bids. Such revisions will be announced by an amendment or amendments to this Invitation for Bids. Copies of each such amendment will be furnished to all prospective bidders. If the revisions and amendments are of a nature which requires material changes in quantities or prices to be bid, the date set for opening bids may be postponed as necessary, in the opinion of the Commander, to enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for opening bids.
- 13.2 **AMENDMENTS TO INVITATIONS FOR BIDS** (a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged. (b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, or (3) by letter or telegram. The Government must receive the acknowledgment by the time and at the place specified for receipt of bids. (FAR 52.214-3.)
14. **WAGE RATE APPLICATION.** Applicable to all work.
15. **ADDITIVE OR DEDUCTIVE ITEMS.** The low bidder for purposes of award shall be the conforming responsible bidder offering the low aggregate amount for the first or base bid item, plus or minus (in the order of priority listed in the schedule) those additive or deductive bid items providing the most features of the work within the funds determined by the Government to be available before bids are opened. If addition of another bid item in the listed order of priority would make the award exceed such funds for all bidders, it shall be skipped and the next subsequent additive bid item in a lower amount shall be added if award thereon can be made within such funds. For example, when the amount available is \$100,000 and a bidder's base bid and four successive additives are \$85,000, \$10,000, \$8,000, \$6,000, and \$4,000, the aggregate amount of the bid for purposes of award would be \$99,000 for the base bid plus the first and fourth additives, the second and third additives being skipped because each of them would cause the aggregate bid to exceed \$100,000. In any case, all bids shall be evaluated on the basis of the same additive or deductive bid items, determined as above provided. The listed order of priority need be followed only for determining the low bidder. After determination of the low bidder as stated, award in the best interests of the Government may be made to him on his base bid and any combination of his additive or deductive bid for which funds are

determined to be available at the time of award, provided that award on such combination of bid items does not exceed the amount offered by any other conforming responsible bidder for the same combination of bid items. (FAR 52.236-7082.)

16. **AVAILABILITY OF SPECIFICATIONS, STANDARDS, AND DESCRIPTIONS.** Specifications, standards, and descriptions cited in this solicitation are available as indicated below:

- 16.1 **UNCLASSIFIED FEDERAL, MILITARY AND OTHER SPECIFICATIONS AND STANDARDS (EXCLUDING COMMERCIAL), AND DATA ITEM DESCRIPTIONS.** Submit request on DD Form 1425 (Specifications and Standards Requisition) to:

Commanding Officer
U.S. Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120

The Acquisition Management Systems and Data Requirements Control List, DOD Directive 5000.19L, Volume II may be ordered on the DD Form 1425. The Department of Defense Index of Specifications and Standards (DODISS) may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When requesting a specification or standard, the request shall indicate the title, number, date, and any applicable amendment thereto by number and date. When requesting a data item description, the request shall cite the applicable data item number set forth in the solicitation. When DD Form 1425 is not available, the request may be submitted in letter form, giving the same information as listed above, and the solicitation or contract number involved. Such requests may also be made to the activity by telex No. 834295, Western Union No. 710-670-1685, or telephone (Area Code 215-697-3321) in case of urgency. (FAR 52.210-2.)

- 16.2 **CORPS OF ENGINEERS SPECIFICATIONS.** Corps of Engineers specifications of the CRD-C series may be obtained from U.S. Army Engineers Waterways Experiment Station, Attn: Publications Distribution, Information Services Branch, P.O. Box 631, Vicksburg, Mississippi.

- 16.3 **COMMERCIAL (NON-GOVERNMENT) SPECIFICATIONS, STANDARDS, AND DESCRIPTIONS.** These specifications, standards, and descriptions are not available from Government sources. They may be obtained from the publishers.

17. **AVAILABLE PLANT.** Each bidder shall, upon request of the Contracting Officer, furnish a list of the plant available to the bidder and proposed for use on the work.

18. **EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE.** Whenever a contract or modification of contract price is negotiated, the Contractor's cost proposals for equipment ownership and operating expenses shall be determined in accordance with the requirements of paragraph: EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE, contained in the Special Clauses section of the specifications. A copy of EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule" is available for review at the office listed in paragraph: SITE INSPECTION herein. (EFARS 52.2/9108(f)).

19. **NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY**

- 19.1 The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

19.2 The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract. Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

19.3 The Contractor shall provide written notification to the Director, Office of Federal Contract Compliance Programs, within 10 working days following award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the:

- (1) name, address, and telephone number of the subcontractor;
 - (i) employer identification number of the subcontractor;
- (2) estimated dollar amount of the subcontract;
- (3) estimated starting and completion dates of the subcontract; and
- (4) geographical area in which the subcontract is to be performed.

19.4 As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is _____
_____ FAR 52.222-23).

20. **NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE.** Any contract awarded as a result of this solicitation will be a DO rated order certified for national defense use under the Defense Priorities and Allocations System (DPAS) (15 CFR 350), and the Contractor will be required to follow all of the requirements of this regulation. (based on FAR 52.212-7)

21. **NOTICE REGARDING BUY AMERICAN ACT (1970 SEP).** The Buy American Act (41 U.S.C. 10a-10d) generally requires that only domestic construction material be used in the performance of this contract. Exception from the Buy American Act shall be permitted only in the case of nonavailability of domestic construction materials. A bid or proposal offering nondomestic construction material will not be accepted unless specifically approved by the Government. When a bidder or offeror proposes to furnish nondomestic construction material, his bid or proposal must set forth an itemization of the quantity, unit price, and intended use of each item of such nondomestic construction material. When offering nondomestic construction material pursuant to this paragraph, bids or proposals may also offer, at stated prices, any available comparable domestic construction material, so as to avoid the possibility that failure of a nondomestic construction material to be acceptable under this paragraph will cause rejection of the entire bid.

22. **COLORADO SALES AND USE TAX.** Specific exemption from the Colorado Sales and Use Taxes will be granted by the Colorado Tax authorities with respect to all materials used by a prime Contractor or subcontractor and which are built into structures furnished under contract to a Government agency. The Colorado Sales and Use Taxes shall be excluded from the bid prices. Exemption certificates are available to both Contractors and subcontractors provided personal application is made therefor to the Department of Revenue, State of Colorado, State Capitol Annex, Denver, Colorado. The Contractor or subcontractor will be required to submit the date of the contract, the amount of the contract, and the proposed date for completion of the contract.
23. **SITE INSPECTION.** Contractors interested in inspecting the site of the proposed work should contact the Area Engineer, U.S. Army Corps of Engineers, _____ Area, _____

_____, Telephone: () _____
24. **CONDUCTED TOUR FOR BIDDERS.** Prospective bidders will be given a conducted tour of the _____ portion of the construction site on _____ 19____. For details as to the hour and place of assembly, etc., contact the Area Engineer, _____
_____. Telephone (_____) _____). Bidders will not be given individual access to (these portions of) the construction site.
25. **BIDDER'S QUESTIONS AND COMMENTS.** Questions and/or comments relative to these bidding documents should be submitted to the Commander, Omaha District, Corps of Engineers, 1612 U.S. Post Office and Courthouse, 215 North 17th Street, Omaha, NE 68102-4978, ATTN: Engineering Division. Comments should reach this office no later than 20 calendar days prior to the date set for opening of bids, if feasible, in order that changes, if needed, may be added by amendment. Telephone calls concerning the purchasing of plans and specifications should be made between 8:45 a.m. and 3:45 p.m. to: (402) 221-4267 or 4268. Telephone calls on bidding matters and small business matters should be made to Advertising and Awards Branch at: (402) 221-4110.
- 25.1 **PLAN HOLDER'S LIST.** A list of plan holders will be prepared and mailed approximately 2 weeks prior to the bid opening date to all who have been issued plans and specifications. This list will be furnished to all other interested parties upon request.
26. **COMPETITIVE INFORMATION CERTIFICATE.** Offerors are hereby notified that the apparently successful offeror(s) as a condition for award of any contract resulting from this solicitation may be required to execute a certificate related to business integrity. The offeror must attach to the certificate a written statement detailing what information was obtained, and how, when and from whom it was obtained.

CAUTION TO BIDDERS - LATE BIDS

See paragraph entitled "Late Submissions, Modifications and Withdrawal of Bids" which provides that late bids and modifications or withdrawals thereof sent through the mails will be considered ONLY IF TIMELY MAILED BY REGISTERED MAIL OR BY CERTIFIED MAIL FOR WHICH A POST-MARKED RECEIPT HAS BEEN OBTAINED AS SPECIFIED IN SUCH PROVISION.

Attachments:

Contract Clauses

General Wage Decision No. _____

Competitive Information Certificate

Standard Form 1442 (Pages SF-1, 2, 2a, 2b, [], [], and Certifications and Representations - Pages SF-3 thru SF-10)

***** COMPETITIVE INFORMATION CERTIFICATE *****

_____ certifies, to the best of its knowledge and belief, that

- (A) With the exception of any information described in an attachment to this certificate, and any information the offeror reasonably believes was made generally available to prospective offerors, the offeror has not knowingly obtained, directly or indirectly from the Government, any written information or oral extract or account thereof relating to this solicitation which was
 - (1) submitted to the Government by offerors or potential offerors in response to the Government's solicitation for bid or proposal;
 - (2) marked by an offeror or potential offeror to indicate the information was submitted to the Government subject to an assertion of privilege against disclosure;
 - (3) marked or otherwise identified by the Government pursuant to law or regulation as classified, source selection sensitive, or for official use only; or
 - (4) the disclosure of which to the offeror or potential offeror by a Government employee would, under the circumstances, otherwise violate law or regulation.

- (B) The offeror named above
 - (1) determined the prices in its offer independently, without, for the purpose of restricting competition, any consultation, communications, or agreement, directly or indirectly, with any other offeror or competitor relating to (a) those prices, (b) the intention to submit an offer, or (c) the methods or factors used to calculate the prices offered;
 - (2) has not knowingly disclosed the prices in its offer, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and
 - (3) has not attempted to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

- (C) The offeror has attached an accurate description of the internal review forming the basis for the certifications provided herein.

Corporate President or Designee

***** COMPETITIVE INFORMATION CERTIFICATE *****

BID PROPOSAL

Place _____

Date _____

Proposal of _____

(hereinafter called "Bidder") (a _____ corporation/ a partnership/ an individual) doing business as (strike out inapplicable terms)

To: _____ (hereinafter called the "owner")

Gentlemen:

The Bidder, in compliance with your Notice to Bidders for Construction of Sanitary Sewage Force Main and Lift Station, having examined the Plans and Specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of materials and labor, hereby proposes to furnish equipment in accordance with the Contact Documents, within the time set forth therein.

Bidder hereby agrees to commence Construction under this contract on or before a date to be specified in written "Notice to Proceed" of the Owner and to fully complete within _____ calendar days thereafter as stipulated.

Bidder further agrees to pay as liquidated damages, the sum of \$ _____ for each consecutive calendar day thereafter as hereinafter provided, in Special Provisions.

Bidder acknowledges receipt of the following Addendum:

Bidder agrees to perform all the work described in the plans and specifications and to provide the following partial breakdown unit prices:

Bid Item	Description of Work Measure	Unit of Measure	Approx. Quantity	Unit Price	Amount
1.	Move in, general conditions and start up including Bonds	L.S.	1		
2.	3" Force Main in open cut including shoring protection, bends and fittings, thrust blocks, bedding	L.F.	3015		
3.	8" Sanitary Gravity Sewer	L.F.	280		
4.	36" Air Release Manholes including Valves and Fittings	Ea.	2		
5.	Construction of Proposed Lift Station, including Structure, Controls, Instrumentation, Electrical, Painting, Valves, Piping, Fittings, Shoring, Site Grading and Excavation. (Power Supply will be brought to the Control Panel by Owner)	L.S.	1		
6.	Backfill and Compact Trench	L.F.	3095		
7.	Testing and Startup of Force Main	L.S.	1		
8.	Health and Safety Compliance and Monitoring	L.S.	1		

Total Base Bid _____

Bid Item	Description of Work Measure	Unit of Measure	Approx. Quantity	Unit Price	Amount
<u>Extra Work Items</u>					
7.	*Removal and Drumming of Contaminated Soil	C.Y			
8.	*Backfill & Compact Material for the Removed Contaminated Soil	C.Y			
9.	*Cost of Upgrading Personal Protection to Level C	L.S.			

*Note: The items listed above are "extra work" items and are to be used only if necessary, with the approval of the Contracting Officer. No compensation will be received for any part of these quantities unless they are approved by the Contracting Officer prior to proceeding with work.

Bidder understands the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

Bidder agrees that this bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for the receiving bids.

Upon receipt of written notice of the acceptance of this bid, bidder will execute the formal contract attached within seven (7) days and delivery of a Surety Bond or Bonds.

The Bid Security attached in the sum of _____ Dollars \$ _____

is to become the property of the Owner in the event the contract and bond are not executed within the time set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Respectfully submitted,

Signature

By _____
Print Name

Title

Address

Phone Number

SEAL - if bid is by a corporation.

ZERO ACCIDENTS

SECTION 01100
SPECIAL CLAUSES

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Attachments:

- Submittal Register (ENG Form 4288)
- Transmittal Form (ENG Form 4025)
- Construction Quality Control Daily Report Form

1. **COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK.** The Contractor shall commence work under this contract within ten (10) calendar days after the date of receipt by him of Notice to Proceed, prosecute said work diligently, and complete the entire work ready for use not later than 60 calendar days after receipt of Notice to Proceed. The time stated for completion shall include final cleanup of the premises and satisfactory operation of the system.

1.1. **START WORK.** Evidence that the Contractor has started procurement of materials, preparation and submission of shop drawings, preparation of subcontracts, and other preparatory work will satisfy the requirement that work commence within ten (10) calendar days after receipt of Notice to Proceed. Therefore, work need not be commenced at the construction site within ten (10) calendar days. (based on FAR 52.212-3)

2. **LIQUIDATED DAMAGES-CONSTRUCTION.**

2.1. **FAILURE TO COMPLY.** If the Contractor fails to complete the work within the time specified in the contract, or any extension, the Contractor shall pay to the Government as liquidated damages according to the following:

Substitution of facilities	\$ _____/day or % day delayed
Rental of Buildings	\$ _____/day or % day delayed
Equipment	\$ _____/day
Penalties	\$ _____/day
TOTAL	\$ _____/day or % day delayed

- 2.2. **CONTRACT TERMINATED.** If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.
- 2.3. **CONTRACT NOT TERMINATED.** If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed and accepted. (based on FAR 52.212-5)

2A. ORDER OF WORK.

- 1) Installation of force main and pumping station.
- 2) Installation of gravity sewer.
- 3) Test check-out and acceptance of new work.
- 4) Plugging old outflow from MH 103A.

Note: These specifications are for the construction and start up of the new sanitary sewer system only.

3. CONTRACT DRAWINGS AND SPECIFICATIONS.

- 3.1. **SETS FURNISHED.** Eleven (11) sets of contract drawings (4 sets of full size and 7 sets of half-size) and specifications (except applicable publications incorporated into the Technical Provisions by reference) will be furnished the Contractor without charge as soon as possible after issue of the Notice To Proceed. Prior to the issue of contract drawings, bid drawings as amended shall be utilized in performance of the work. The work shall conform to the contract drawings, set out in the drawing index, all of which form a part of these specifications. The work shall also conform to the standard details bound or referenced herein.
- 3.2. **NOTIFICATION OF DISCREPANCIES.** The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Dimensions marked on drawings shall be followed in lieu of scale measurements. Enlarged plans and details shall govern where the same work is shown at smaller scales. The Contractor shall compare all drawings and verify the figures and dimensions before laying out the work and will be responsible for any errors which might have been avoided thereby.

4. SUBMITTALS.

- 4.1. **SUBMITTAL REGISTER (ENG FORM 4288).** The Contractor will be furnished one (1) set of ENG Forms 4288 at the preconstruction conference on which will be listed each item of equipment and material of each type for which fabricators drawings, and/or related descriptive data, test reports, samples, spare parts lists, O&M manuals, or other types of submittals are required by the specifications. Columns 3, 4, 5, 6, 12, and 13 of ENG Form 4288 will be completed by the Government. A copy of the ENG Form 4288 may be obtained by written request to CEMRO-ED-DI, 215 N. 17th Street, Omaha, NE 68102-4978. The Contractor shall complete columns 7, 8, and 9 within ten (10) calendar days after the preconstruction conference and return six (6) completed copies to the Contracting Officer's Representative for approval. Dates entered in columns 7 and 8 shall not include mail or delivery time. The ENG Forms 4288 will become a part of the contract after approval. Column 2 shall be left blank for use later to record the respective transmittal and item number indicated for the submittal items(s) listed on the transmittal form entitled: "TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE" (ENG Form 4025).

4.1.1. **Scheduling.** Drawings on component items forming a system or that are interrelated shall be scheduled to be correlated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 10 calendar days exclusive of mailing time) will be allowed on the register for review and approval and possible resubmittal of any items subject to approval. No delay damages or time extensions will be allowed for time lost in late submittals or resubmittals for such items.

4.1.2. **Application to Contract.** The approved submittal register will become a part of the contract and Contractor will be subject to requirements thereof. This register and the progress schedules shall be coordinated.

4.2. **SUBMITTAL PROCESS.** The Contractor shall submit all items listed on the contract drawings and listed or specified in the other sections of these specifications. The Contracting Officer may request submittals in addition to those listed 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 used in the contract drawings. Submittals shall be made in the respective number of copies and to the respective addresses set forth below. Each submittal shall be complete and in sufficient detail for ready determination of compliance with the contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) Engineer and each respective transmittal form (ENG Form 4025) shall be stamped, initialed, and dated by the CQC Engineer certifying that the accompanying submittal complies with the contract requirements. Submittals shall include such items as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operation charts or curves; test reports; test cylinders; samples, O&M manuals including parts lists; certifications; warranties and other such required submittals. Submittals pertinent to materials and equipment which are subject to advance approval shall be scheduled and made prior to the acquisition or the delivery thereof.

4.2.1. **Categories of Submittals.** The categories of items specified to be submitted shall be submitted as follows:

4.2.1.1. **Category I.** All items listed as Category I submittals in the various sections shall be mailed directly to the addressee shown below as directed. For each submittal, a completed information copy of the attached transmittal form shall also be mailed to the Area Engineer and to the Construction Division of the Omaha District.

Technical Reviewer

Abbreviations Used in Column
6 of Submittal Register

Engineering Division
Attn: CEMRO-ED-DI
U.S. Army Engineer District, Omaha
215 North 17th Street
Omaha, NE 68102-4978

"ED"

Each required submittal which is in the form of a drawing shall be submitted as one (1) reproducible and one (1) print of the drawing. Drawing prints shall be either blue or black line permanent-type prints on a white background or blueprint. Reproducibles shall be brownline diazo or sepia and shall be of such quality that prints made therefrom are sufficiently clear for microfilm copying. All catalog and descriptive data shall be submitted in eight (8) copies. Catalog cuts and other descriptive data which have more than one model, size, or type or which shows optional equipment shall be clearly marked to show the model, size, or type and all optional equipment which is proposed for approval. Submittals on component items forming a system or that are interrelated

shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function as a unit.

- 4.2.1.2. **Category II.** Except as noted below, data for all items listed as Category II Submittals in the various sections shall be submitted in five (5) copies to the Area Engineer using the transmittal form. Items not to be submitted in quintuplicate, such as samples and test cylinders, shall be submitted to the Area Engineer accompanied by five (5) copies of the transmittal form.

Technical Reviewer

Abbreviations Used in Column
6 of Submittal Register

Area Engineer
Army Corps of Engineer
2032 North Academy Boulevard
Colorado Springs, Colorado 80909-1506

"AREA"

- 4.2.2. **Control of Submittals.** The Contractor shall carefully control his procurement operations to assure that each individual submittal is made on or before the corresponding date scheduled on his approved "SUBMITTAL REGISTER."
- 4.2.3. **Transmittal Form (ENG Form 4025).** The sample transmittal form attached to this section shall be used for submitting both the Category I and Category II submittals, in strict accordance with the instructions on the reverse side thereof. 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 should 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. A separate transmittal form shall be attached to each copy of the data being submitted.
- 4.2.4. **Approval Action.**
- 4.2.4.1. **Category I.** All Category I submittals are subject to advance approval. Upon completion of review of Category I submittals, the drawing reproducible and print and other pertinent data will be identified as having received approval by being so stamped and dated. The drawing print and six (6) sets of all catalog data and descriptive literature will be retained by the Contracting Officer and the drawing reproducible and two (2) sets of catalog data and descriptive literature will be returned to the Contractor.
- 4.2.4.2. **Category II.** Submittals may be required for "Approval" or for "Information Only." Within the terms of the CONTRACT CLAUSES clause entitled "Specifications and Drawings for Construction," Category II submittals "for approval" are considered to be "shop drawings" and Category II submittals "for information only" are not considered to be "shop drawings." Two (2) copies of Category II submittals for approval will be returned to the Contractor except for samples, test cylinders, and O&M manuals for which two (2) copies of the transmittal form only will be returned to the Contractor. Submittals for "Information Only" will not be returned to the Contractor. No Corps of Engineers' approval action will be required prior to incorporating these "Information Only" items into the work. These Contractor approved "Information Only" submittals will be used to verify that material received and used in the job is the same as that described in the plans and specifications and will be used as record copies. Delegation of this approval authority to the CQC Engineer does not relieve the Contractor from the obligation to furnish material conforming to the

plans and specifications and will not prevent the Contracting Officer from requiring removal and replacement if nonconforming material is incorporated in the work. This obligation does not relieve the Contractor from the requirement to furnish samples for testing by the Government laboratory or check testing by the Government in those instances where the technical specifications so prescribe.

- 4.2.5. Meaning of Approvals.** The approval of the submittals by the Contracting Officer or his authorized representative shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist as the Contractor, under the CQC requirements of this contract, is responsible for the dimensions and design of adequate connections, details and satisfactory construction of all work. After submittals have been approved by the Contracting Officer or his authorized representative, no resubmittal for the purpose of substituting materials or equipment will be given consideration unless accompanied by an acceptable explanation as to why a substitution is necessary.
- 4.2.6. When Not Approved.** The Contractor shall make all corrections required by the Contracting Officer or his authorized representative and promptly furnish a corrected submittal in the form and number of copies as specified for initial submittals. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, notice as required under the CONTRACT CLAUSES clause entitled "Changes" should promptly be given to the Contracting Officer.
- 4.2.7. Withholding of Payment.** Payment for materials incorporated into the work will not be made if required approvals have not been obtained.
- 4.3. CERTIFICATES OF COMPLIANCE.** Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in three copies. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements. (EFARS 52.2/9108(c))
- 4.4. PURCHASE ORDERS.** Each purchase order issued by the Contractor or his subcontractors for materials and equipment to be incorporated into the project shall (1) be clearly identified with the 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. Copies of purchase orders shall be furnished to the Contracting Officer when requested by the Contracting Officer for the purpose of quality assurance review.
- 4.5. OPERATION AND MAINTENANCE INSTRUCTIONS AND/OR MANUALS.** Where required by various technical sections, operations and maintenance instructions and/or manuals with parts lists included shall be provided by the Contractor in quintuplicate, unless otherwise specified, and shall be assembled in book form having a cover indicating the contents by equipment or system name and project title and shall be submitted for approval to the Contracting Officer 30 days prior to final tests of mechanical and electrical systems. Each operation and maintenance manual shall contain a copy of all warranties and a list of local service representatives required by SECTION: WARRANTY OF CONSTRUCTION. If field testing requires these copies to be revised, they shall be updated and resubmitted for approval within 10 calendar days after completion of tests. The Operations and Maintenance Instructions and/or Manuals shall be shown as a separate activity on the Contractor prepared construction schedule bar chart or network analysis system.

5. **PHYSICAL DATA.** Pursuant to CONTRACT CLAUSES clause: "Site Investigation and Conditions Affecting the Work," information and data furnished or referred to below are furnished for general information only and the Government may not be held liable for any interpretation or conclusions drawn therefrom by the Contractor.
- 5.1. **SOURCE OF DATA.** The physical conditions indicated on the drawings and in the specifications are the result of site.
- 5.2. **WEATHER.** Weather conditions shall have been investigated by the Contractor to satisfy himself as to the hazards likely to arise therefrom. Complete weather records and reports may be obtained from the local U.S. Weather Bureau.
- 5.3. **ACCESS ROUTES.** Transportation facilities shall have been investigated by the Contractor to satisfy himself as to the existence of access highways and railroad facilities. (based on FAR 52.236-4)
- 5.4. **CONCURRENT CONSTRUCTION.** Construction work closely related to and/or located at the site of the work under this contract, including Interim Response Actions will be in progress simultaneously with work under this contract. The location of this concurrent work is in various areas around the Base. The Contractor shall cooperate with others as necessary in the interest of timely completion of all work. In the event of interference, the Contracting Officer shall be notified immediately for resolution and his decision shall be final. All road crossings shall be maintained and shall be passable at all times. Short, temporary detours shall be coordinated with the base commander and the Fire Department.
- 5.5. **TELEPHONE SERVICE.** Telephone and radio service for Contractor facilities shall will be the Contractor's responsibility.
6. **PAYMENT.**
- 6.1. **PROMPT PAYMENT ACT.** Pay requests authorized in CONTRACT CLAUSES clause: "Payments Under Fixed-Price Construction Contracts", will be paid pursuant to the clause: "Prompt Payment for Construction Contracts". Pay requests will be submitted on ENG Form 93 and 93a, "Payment Estimate-Contract Performance" and "Continuation". All information and substantiation required by the identified contract clauses will be submitted with the ENG Form 93, and the required certification will be included on the last page of the ENG Form 93a, signed by an authorized contractor official and dated when signed. The designated billing office is the Office of the Area Engineer.
- 6.2. **PAYMENTS FOR MODIFICATIONS.** Payments may be made for cost bearing change orders within the scope of the contract only to the extent funds are authorized in the order on a two-part modification. Contractor pricing proposed must be submitted at the earliest possible time after the change order is issued, or at a specific time as directed by the Contracting Officer. At the discretion of the Contracting Officer, any and all payments may be withheld on the modification until the Contractor has submitted a qualifying price proposal, in as much detail as required by the Contracting Officer, and the final price has been agreed.
- 6.3. **PAYMENT FOR MATERIALS DELIVERED OFFSITE.** No payment will be made for materials that are not on site and intended for exclusive use on this project.
7. **AVAILABILITY OF UTILITY SERVICES.** Water and electricity are not readily available at this site. It will be the contractor's responsibility to provide for the utilities that may be required for the successful completion of this project. Non-potable water is available on base at the Fire Department, but the Contractor shall be responsible for transporting, storing, and coordinating dispensing with the Fire Department. All required drinking water and personal wash water shall be furnished by the contractor.

8. **UTILITY SERVICE INTERRUPTIONS.** The Contractor shall not disrupt base utilities as part of this project. The contractor shall cause all utilities in the vicinity of this project to be located and marked. Contractor shall protect marked utilities during the duration of this project. The contractor must arrange for telephone with U.S. West.
- 8.1. **OVERTIME WORK BY BASE OPERATING AND MAINTENANCE (O&M) PERSONNEL.** The normal working hours for Government O&M personnel whose services may be required for utility outages or similar services are from 7:30 a.m. to 4:00 p.m. Overtime work by Government O&M personnel due to Contractor delays in scheduled outages, interruptions of known utility services, or other negligent acts, shall be the responsibility of the Contractor. The Contractor shall pay the Government for such additional overtime costs at the existing overtime wage rates established for the Government personnel involved.
- 8.2. **BURIED UTILITIES.** The Contractor shall coordinate all excavation work including excavation for sign posts, fence posts, and utility poles with the Using Service Facilities Engineer and the telephone company prior to beginning work. The contractor will corroborate with the contracting officers of the utility companies.
- 8A. **DIGGING PERMITS AND ROAD CLOSINGS.** The Contractor shall allow 14 calendar days from date of written application to receive permission to dig and to close roads. Roads shall only be closed one lane at a time and vehicular traffic shall be allowed to pass through the construction area. Work on or near roadways shall be flagged in accordance with the safety requirements in Safety and Health Requirements Manual EM 385-1-1, which forms a part of these specifications. Work located along the alert force route shall not cause blockage and the Contractor shall maintain unobstructed access for alert force traffic at all times.
9. **LAYOUT OF WORK.** The Contractor shall lay out his work from Government established bench marks indicated on the drawings and shall make all measurements in connection therewith. The Contractor shall furnish all stakes, templates, platforms, equipment, tools, and materials and labor as may be required in laying out any part of the work from the base lines and marks established by the Government. The Contractor shall execute the work to the lines and grades established or indicated and shall maintain and preserve all stakes and other control points established by the Contracting Officer until authorized to remove them. If such marks are destroyed by or through negligence of the Contractor, 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. (based on FAR 52.236-17)
10. **TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER.**
- 10.1. **ANTICIPATED WEATHER DELAYS.** Time extensions requested for adverse weather delays shall be based upon weather conditions that affect normal working days and are unexpected on unusually severe for the time of year at the site. Delay claims must be made in writing to the contract offices within 24 hours of the claimed weather occurrence. Claims for weather delay shall be for extension of the contract time only. Cost claims for extended overhead, etc. will not be allowed. No more than 5 days will be allowed for weather related delay claims.
- 10.2. **THE CONTRACTOR'S SCHEDULE** must reflect the above anticipated adverse weather delays on all weather dependent activities.
11. **INSURANCE REQUIRED.** In accordance with CONTRACT CLAUSES clause: "Insurance Work on a Government Installation," the Contractor shall procure the following minimum insurance:

<u>Type</u>	<u>Amount</u>
Workmen's Compensation and Employer's Liability Insurance	\$100,000
General Liability Insurance	\$500,000 per occurrence
Automobile Liability Insurance Bodily injury	\$200,000 per person and \$500,000 per occurrence
Property damage	\$ 20,000 per occurrence

(Coverages per FAR 28.307-2)

- 12. **IDENTIFICATION OF EMPLOYEES.** The Contractor shall furnish to each employee and require each employee engaged on the work to display, such identification as may be approved and directed by the Contracting Officer. All prescribed identification shall immediately be delivered to the Contracting Officer, for cancellation upon release of any employees. When the contract involves work in restricted security areas, only employees who are U.S. citizens will be permitted to enter. Proof of U.S. citizenship is required prior to entry. When required by the Contracting Officer, the Contractor shall obtain and submit fingerprints of all persons employed or to be employed on the project. (based on FAR 52.236-7007)

- 13A. **VEHICLE IDENTIFICATION.** All privately owned vehicles including Contractor pickups, but not heavy equipment or trailer towed equipment shall be registered while working on post. Contractor personnel shall register their vehicles at the Arsenal Security Office, Building 135 located at 72nd Avenue and Quebec Street any work day between the hours of 0700-1115 and 1300-1600. A safety inspection will be required and each vehicle owner will need to show (1) a valid driver's license, (2) a current vehicle registration, (3) proof of automobile liability insurance, and (4) proof of State of Colorado required vehicle emissions, check having been passed.

- 14. **CONTRACTOR QUALITY CONTROL (CQC).** In conformance with the requirements of CONTRACT CLAUSES clause: "Inspection of Construction," the Contractor shall establish and maintain an effective Quality Control Program.
 - 14.1. **GENERAL.** Except for isolated tests or other items of work specified to be performed by the Government, the quality of all work shall be the responsibility of the Contractor. Sufficient inspections and tests of all items of work, including that of subcontractors, to ensure conformance to applicable specifications and drawings with respect to the quality of materials, workmanship, construction, finish, functional performance, and identification shall be performed on a continuing basis. The Contractor shall furnish qualified personnel, appropriate facilities, instruments and testing devices necessary for the performance of the quality control function. The controls shall be adequate to cover all construction operations both on and offsite, shall be keyed to the proposed construction sequence and shall be correlated by the Contractor's quality control personnel.

 - 14.2. **PRECONSTRUCTION PLANNING.** The Government will consider an interim CQC plan for the first days of operation. However, within ten (10) calendar days after the date of receipt by him of Notice to Proceed, and prior to starting on-site construction, the Contractor shall meet with the Contracting Officer and discuss the quality control requirements. During this meeting the Contractor shall submit for approval his proposed written QC plan which shall include all features outlined below. The proposed plan will be reviewed and the meeting shall develop mutual understanding relative to details of the system, including the personnel, facilities, forms, etc., to be used for the inspections, tests and the administration of the system. Minutes of the meeting shall be prepared by the Area Office Resident Engineer or Contractor as agreed to at the mutual understanding meeting and shall be signed by both the Contractor and the Contracting Officer or Contracting Officer's Representative. The minutes shall become a part

of the contract. No change in the approved plan shall be implemented without written concurrence by the Contracting Officer.

- 14.3. **ACCEPTANCE OF CQC PLAN.** Acceptance of the Contractor's quality control 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 as necessary to obtain the quality specified.
- 14.4. **CONTRACTOR'S PROPOSED (QC) PLAN.** The Contractor's proposed written quality control plan (for submittal at the mutual understanding meeting) shall include as a minimum:
 - 14.4.1. The quality control organization.
 - 14.4.2. Names, number, and qualification of personnel to be used for this purpose.
 - 14.4.3. Authority and responsibilities of all quality control personnel.
 - 14.4.4. Schedule of Use of inspection personnel by types and phase of work.
 - 14.4.5. A list of preparatory and initial inspections to be performed shall be included as part of the Quality Control Program.
 - 14.4.6. A list of tests specified to be performed with proposed test methods including specification paragraph number and names of technicians or qualified testing laboratory to be used.
 - 14.4.7. Location and availability of test facilities and equipment.
 - 14.4.8. Procedures for advance notice and coordination of special inspections and tests where required.
 - 14.4.9. Procedures for reviewing all shop drawings, samples, certificates, or other submittals for contract compliance and certifying them for submission to the Government.
 - 14.4.10. Method of performing, documenting, and enforcing quality control operations of both prime and subcontract work including inspection and testing both onsite and offsite. Include proposed forms for approval, and indicate who will prepare, sign, and submit the reports.
 - 14.4.11. Responsibilities and procedures for correcting deficiencies.
 - 14.4.12. A copy of a letter of direction to the Contractor's representative responsible for quality control, outlining his duties and responsibilities, and signed by a responsible officer of the firm.
 - 14.4.13. Method of documenting and tracking deficiencies and corrective actions.
- 14.5. **CONTROL OF ON-SITE CONSTRUCTION.** The Contractor's quality control program shall include four phases of inspection and tests. The Contracting Officer's representative shall be notified at least 24 hours in advance of each such test
 - 14.5.1. Preparatory inspections shall be performed prior to beginning each feature of work on any on-site construction work. Preparatory inspections for the applicable feature of work shall include (i) review of submittal requirements and all other contract requirements with the foremen or supervisors directly responsible for the performance of the work; (ii) check to assure that provisions have been made to provide required field control testing; (iii) examine the work area to ascertain that all preliminary work has been completed; (iiii) verify all field dimensions and

advise the Contracting Officer of any discrepancies; and (iiii) perform a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand.

- 14.5.2. Initial Inspection shall be performed as soon as work begins on a representative portion of the particular feature of work and shall include examination of the quality of workmanship as well as a review of control testing for compliance with contract requirements.
 - 14.5.3. Follow-up Inspections shall be performed continuously as any particular feature of work progresses, to assure compliance with contract requirements including control testing, until completion of that feature of the work.
 - 14.5.4. Safety Inspections. The Contractor shall perform daily safety inspections of the jobsite and the work in progress to assure compliance with EM 385-1-1 and other occupational health and safety requirements of the contract. Daily Quality Control reports as required under paragraph: REPORTING shall be used to document the inspection and shall include a notation of the safety deficiencies observed and the corrective actions taken. The Contractor shall use his designated Quality Control Staff to perform the required inspections and shall supplement the staff with additional personnel as required. Additional personnel shall be provided at no additional cost to the Government.
 - 14.5.5. Recording Inspection Results. The results of all inspections shall be made a matter of record in the Contractor's Quality Control documentation as required by paragraph DOCUMENTATION below.
- 14.6. **QUALITY CONTROL STAFF.** In addition to the Contractor's job supervisory staff, a separate quality control group shall be provided. This group shall report to the Contractor's management at a level no lower than an executive of the company. The individuals itemized here may be the project superintendant if all other qualifications are met. As a minimum, the overall strength of the quality control group for this contract shall be as follows:
- 14.6.1. The Quality Control enforcing officer shall be an approved, qualified engineer or technician whose sole responsibility is to ensure compliance with the contract plans and specifications. This person shall demonstrate ability to perform correctly the duties required to the satisfaction of the Contracting Officer and shall be physically at the project site whenever work is in progress and will be in charge of the Contractor's Quality Control program for this project. All the Contractor's submittals for approval shall be reviewed and modified or corrected as needed by the Quality Control enforcing officer (or authorized assistants) and approved correct prior to forwarding of such submittals to the Contracting Officer.
 - 14.6.2. A Mechanical Technician, who is experienced in the construction of industrial air-conditioning, steam and sewer systems, plumbing, heating, mechanical tests, and other components of mechanical devices equipment and/or systems in the work, shall assist in performance of the QC Supervisory Engineer's duties. The Mechanical Technician may have other duties but shall be on the project site at the times indicated in both the approved QC Plan and Progress Chart.
 - 14.6.3. An Electrical Technician, experienced in the construction of industrial electrical systems, overhead and underground high voltage systems, instrumentation and control systems, and the required electrical tests shall assist in performance of the QC Supervisory Engineer's duties. The Electrical Technician may have other duties but shall be on the project site at the times indicated in both the approved QC Plan and Progress Charts.

14.6.4. A Certified Industrial Hygienist (CIH) and an Industrial Hygiene Technician shall assist in the performance of the QC Supervisory Engineer's duties. The CIH will provide monitoring services, authorize proper use of personal protective equipment, etc. The CIH should also be the Safety and Occupational Health Officer (S.O.H.).

14.7. TESTS.

14.7.1. **Testing Procedure.** The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements. The Contractor shall procure the services of an industry recognized testing laboratory approved by the Contracting Officer, or may establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

14.7.1.1. Verify that testing procedures comply with contract requirements.

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

14.7.1.3. Check test instrument calibration data against certified standards.

14.7.1.4. Verify that recording forms, including all of the test documentation requirements, have been prepared.

14.7.2. **Testing.**

14.7.2.1. **Capability Check.** The Contracting Officer's Representative (COR) will have 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.

14.7.2.2. **Capability Re-Check.** If the selected laboratory fails the capability check, the Contractor will be assessed the actual cost for the re-check as reimbursement to the Government for each succeeding re-check of the laboratory or the checking of a subsequently-selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

14.7.2.3. **Project Laboratory.** The COR will have 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.

14.8. **REPORTING.** All inspections and test results shall be recorded daily.

14.8.1. **Daily Submittals.** The attached sample "Quality Control Daily Report" form or other approved form shall be reproduced and fully executed to show all inspections and tests and submitted in duplicate to the Contracting Officer's representative on the first work day following the date covered by the report.

14.8.2. **Results of Tests.** Triplicate copies of complete results of tests shall be submitted not later than 3 calendar days after performing the test.

14.9. **COMPLETION INSPECTIONS.**

14.9.1. **Contractor's Quality Control Completion Inspection.** Based upon the Contracting Officer's concurrence that the work is nearing substantial completion,

and at least 14 days prior to pre-final inspection, the Contractor's Quality Control Inspection personnel shall conduct a detailed inspection. The Contracting Officer's Representative shall be notified of the inspection date in order that he may participate, if he so elects. The work shall be inspected for conformance to plans, specifications, quality, workmanship, and completeness. The Contractor shall prepare an itemized list of work not properly completed, inferior workmanship, or not conforming to plans and specifications. The list shall also include outstanding administrative items such as as-built drawings, O&M Manuals, and spare parts. The list shall be included in the Quality Control documentation and submitted to the Contracting Officer with an estimated date for correction of each deficiency within five (5) working days after conducting this inspection.

14.9.2. Pre-Final Inspection. The Contractor's Quality Control Inspection personnel, his superintendent, or other primary management person and the Contracting Officer's representatives will be in attendance at this inspection. Additional Government personnel, including but not limited to those from Base/Post Civil/Facility Engineer, user groups and major commands may be in attendance. The prefinal inspection will be formally scheduled by the Contracting Officer based upon notice from the Contractor. This notice will be given to the Contracting Officer at least 14 days prior to the pre-final inspection and must include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining contract work, will be complete and acceptable by the date scheduled for the prefinal 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 costs in accordance with the contract clause entitled, "Inspection of Construction." At this inspection the Contracting Officer will develop a specific list of incomplete and/or unacceptable work performed under the contract and will subsequently furnish this list to the Contractor. Failure of the Contracting Officer to detect and list all incomplete and/or unacceptable work during this inspection will not relieve the Contractor from acceptably performing all work required by the contract documents.

14.9.3. Final Acceptance Inspection. The Contractor's Quality Control Inspection personnel, his superintendent or other primary management person and the Contracting Officer's representative will be in attendance at this 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 notice from the Contractor. This notice will be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and must 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 costs in accordance with the contract clause entitled "Inspection of Construction".

14.10. DOCUMENTATION.

14.10.1. The Contractor shall maintain current records of quality control operations, activities, and tests performed including the work of suppliers and subcontractors. These records shall be on an acceptable form and indicate a description of trades working on the project, the number of personnel working, the weather conditions encountered, any delays encountered, and acknowledgment of deficiencies noted along with the corrective actions taken on current and previous deficiencies. These records shall include factual evidence that required activities or tests have been performed, including but not limited to the following:

- 14.10.1.1. Type, number, and results of control activities and tests involved.
 - 14.10.1.2. Nature of defects and causes of rejection.
 - 14.10.1.3. Proposed remedial action.
 - 14.10.1.4. Corrective actions taken.
- 14.10.2. These records shall cover both conforming and defective or deficient features and shall include a statement that supplies and materials incorporated in the work comply with the contract. Legible copies of these records shall be furnished to the COR daily.
- 14.11. **ENFORCEMENT.** The Contractor shall stop work on any item or feature, pending satisfactory correction of any deficiency noted by his quality control staff or by the Contracting Officer's representative. Construction shall not proceed upon any feature of work containing uncorrected work. Notations on quality control reports will not be acceptable as a substitution for other written reports by the Contractor if required under CONTRACT CLAUSES clause: "Changes," "Differing Site Conditions," or "Default (Fixed-Price Construction)."
- 14.12. **NOTIFICATION OF NONCOMPLIANCE.** The Contracting Officer will notify the Contractor of any noncompliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his representative at the site of the work, 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 any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.
- 14.13. **PAYMENT.** At the election of the Contracting Officer, no payment estimate will be processed under this contract until the entire Quality Control Plan has been approved or until overdue daily QC reports are properly executed and furnished.
15. **NONDOMESTIC CONSTRUCTION MATERIALS.** The requirements of this contract entitled Buy American Act Construction Materials apply to construction materials and their components included in the list set forth in paragraph 25.108 of the Federal Acquisition Regulation.
16. **DAILY WORK SCHEDULES.** In order to closely coordinate work under this contract, the Contractor shall prepare for and attend a weekly coordination meeting with the Contracting Officer and Using Service at which time the Contractor shall submit for coordination and approval, his proposed daily work schedule for the next two week period. Required temporary utility services, and protection of adjoining areas shall be included with the Contractor's proposed 2-week work schedule. Coordination action by the Contracting Officer relative to these schedules will be accomplished during these weekly meetings.
17. **AS-BUILT DRAWINGS.** The Contractor shall maintain two 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. The location, general description, approximate depth below finished grade of all underground utilities encountered, and all variations from the contract drawings, for whatever reason, including those occasioned by optional materials and the required coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the initial contract drawings. Both sets of as-built construction drawings shall be furnished to the Contracting Officer on the date of final inspection. The submittal requirement for as-built construction drawings shall be shown as a separate activity on the Contractor prepared progress bar chart or network analysis system, whichever is applicable.

18. SUPERINTENDENCE OF SUBCONTRACTORS.

18.1. ADDED SUPERINTENDENTS. The Contractor shall furnish the following, in addition to the superintendence required by the CONTRACT CLAUSES clause entitled "Superintendence by the Contractor."

18.1.1. If more than 50 percent and less than 70 percent 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.

18.1.2. If 70 percent 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.

18.2 WAIVER OF ADDED SUPERINTENDENTS. If the Contracting Officer, at any time after 50 percent 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. (based on FAR 52.236-7008)

19. TIME EXTENSIONS. Notwithstanding any other provisions of this contract, the time extensions for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the contract completion date will be extended only for those specific elements so delayed and that the remaining contract completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages pursuant to the new completion schedule. (based on FAR 52.212-6)

20. OPERATIONS AND MAINTENANCE DATA AND TRAINING REQUIREMENTS.

20.1. The Operations and Maintenance Data required by this paragraph is in addition to Operations and Maintenance Instructions and/or Manuals required in: OPERATIONS AND MAINTENANCE INSTRUCTIONS AND/OR MANUALS. The Operations and Maintenance Data required by this paragraph shall be shown as a separate activity on the construction schedule bar chart or network analysis system.

20.2. Operations and Maintenance Data shall consist of one (1) corrected copy of all Categories I and II submittals including one (1) updated copy of all Operations and Maintenance Instructions and/or Manuals. The Operations and Maintenance Data shall be checked for completeness, indexed, packaged, and shall be submitted to the Contracting Officer at time of contract completion and shall be addressed to: Engineering Division CEMRO-ED-DI U.S. Army Engineer District, Omaha, 215 North 17th Street, 1612 U.S. Post Office and Courthouse, Omaha, NE 68102-4978.

20.3. TRAINING. The Contractor shall provide training for base personnel on the systems and system's components listed below. Where a minimum number of training hours are not specified, the instruction period shall be of sufficient length to explain the operation, maintenance, repair, and checkout procedures of the system. Where training required by technical sections of these specifications is longer than the training required below, the longer training period shall be used. Following training and initial system startup and testing, the Contractor shall supervise Base personnel in performing system startup and testing. Base personnel will follow the Contractor's operation instructions provided.

- a. Hoists and Trolleys.
- b. Pumps and controls (min 2 hrs.).
- c. Plumbing, Backflow Preventive Devices (Testing and Maintenance).

- e. Alarm Testing Procedures.
- g. Exterior Electrical.
 - (1) Operating and Troubleshooting (2 hrs).
 - (2) Maintenance (Min 2 hrs).
- h. Interior Electrical.
 - (1) Startup Procedures (Motor Control Center) (Min 2 hrs).
 - (2) Maintenance of Controllers including Electric Watt/Demand Meter (Min 2 hrs).
- i. Cathodic Protection, Review of Manual.

21. **APPLICABILITY OF DAVIS-BACON ACT.** It is the position of the Department of Defense that the Davis-Bacon Act, 40 U.S.C. 276a is applicable to temporary facilities such as batch plants, sandpits, rock quarries, and similar operations, located off the immediate site of the construction but set up exclusively to furnish required materials for a construction project on the site of the work. Clause "Payrolls and Basic Records" of the CONTRACT CLAUSES is applicable to such operations.

furnished by the Government nor for the repair of any damage that results from any defect in Government furnished material or design.

- 1.9. This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.
 - 1.10. Defects in design or manufacture of equipment specified by the Government on a "brand name and model" basis, shall not be included in this warranty. In this event, the Contractor shall require any subcontractors, manufacturers, or suppliers thereof to execute their warranties, in writing, directly to the Government. (Based on FAR 52.246-21)
2. **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 24 hours for all 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.

ZERO ACCIDENTS

SECTION 01300 ENVIRONMENT PROTECTION

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| 7. | WASTE DISPOSAL | | |

1. **GENERAL.** The Contractor shall perform all work in such manner as to minimize the polluting of air, water, or land, and shall, within reasonable limits, control noise and the disposal of solid waste materials, as well as other pollutants.
2. **IMPLEMENTATION.** Within 20 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall:
 - 2.1. Submit in writing his detailed proposal for implementing the requirements for environmental pollution control specified herein.
 - 2.2. Meet with representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.
3. **PRECONSTRUCTION SURVEY.** Prior to start of any on-site construction activities, the Contractor and the Contracting Officer shall make a joint condition survey after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access route(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.
4. **PROTECTION OF LAND AREAS.** Except for any work or storage area and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSES clause: "Protection of Existing Vegetation, Structures, Utilities and Improvements," be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSES clause: "Operations and Storage Areas," storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contracting Officer.
5. **PROTECTION OF TREES AND SHRUBS.** CONTRACT CLAUSES clause: "Protection of Existing Vegetation, Structures, Utilities and Improvements," is hereby supplemented as follows: Except for trees or shrubs marked on the plans to be removed, the Contractor shall not deface, injure or destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages.

- 5.1. **TREE PROTECTIVE STRUCTURES.** Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, planks, or poles around them.
- 5.2. **RESTORATION OF DAMAGED TREES.** Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on trees not designated on the plans to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor so as to be beyond saving in the opinion of the Contracting Officer, shall be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.
6. **PROTECTION OF WATER RESOURCES.** The Contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids or harmful materials, both on and off the Government premises and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides, and insecticides from entering public waters. Water used in on-site material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result therefrom.
7. **WASTE DISPOSAL.** As part of his proposed implementation under paragraph 2, and prior to on-site construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is dumped in unauthorized areas, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.
8. **BURNING.** Air pollution restrictions applicable to this project are as follows. Material shall not be burned on the Government premises. If the Contractor elects to dispose of waste materials off the Government premises, by burning, he shall make his own arrangements for such burning area and shall, as specified in CONTRACT CLAUSES clause: "Permits and Responsibilities," conform to all local regulations.
9. **DUST CONTROL.** The Contractor shall maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.
10. **EROSION CONTROL.** Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.

11. **CORRECTIVE ACTION.** The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. 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 any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.
12. **POST-CONSTRUCTION CLEANUP OR OBLITERATION.** In accordance with CONTRACT CLAUSES. 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 areas, 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 areas shall be graded and filled and the entire area seeded.
13. **UST FUEL TANKS.** The Contractor shall notify the Contracting Officer a minimum of 7 days prior to installation of underground fuel storage tank(s).

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SECTION 01400 SPECIAL SAFETY REQUIREMENTS

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1. **GENERAL.** This section provides additional requirements for implementing the accident prevention articles in CONTRACT CLAUSES clause: "Accident Prevention" and Safety and Health Requirements Manual EM 385-1-1.
2. **PRECONSTRUCTION CONFERENCE.** A preconstruction conference will be scheduled prior to beginning of site work at which time representatives of the Contracting Officer will review and discuss requirements relative to planning and administration of the overall safety program.
3. **ACCIDENT PREVENTION PROPOSAL.** The Contractor shall submit his own accident prevention program and Health & Safety Plan. As a minimum it will incorporate or cover the basic points as outlined in subparagraphs 3.1 through 3.11 and the site health and safety plan.
 - 3.1. **RESPONSIBLE INDIVIDUAL.** The Contractor shall designate an approved onsite employee as the individual responsible for insuring the accident prevention proposal is implemented, enforced, and that inspections of scaffolding, mechanical equipment and hand tools are made as required. This individual should also provide health and safety monitoring and control as their sole job responsibility.
 - 3.2. **INDOCTRINATION OF EMPLOYEE BEFORE START OF WORK.** The Contractor shall indoctrinate each employee to insure the following items are covered:
 - (a) Purpose of the accident prevention program (i.e., to minimize the hazards and reduce injuries).
 - (b) Review of representative hazards on the job and the precautions to be taken.
 - (c) Location of first aid and other emergency facilities and what to do in case of injury, fire or when a serious hazard is noted.
 - (d) Time and location of Tool Box Safety Meetings.
 - (e) Required protective equipment such as goggles, respirators, lifelines, and hard hats.
 - (f) Brief review of clean-up procedure.
 - (g) Location of company safety rules (posting or handout).
 - (h) Hazards at the Arsenal.

- 3.3. **TOOL BOX SAFETY MEETINGS.** Hold weekly Tool Box Safety Meetings for all contractor employees. Timely safety subjects shall be determined by a responsible individual. Submit written notice to the Contracting Officer.
 - 3.4. **FIRE PROTECTION AND PREVENTION.** Insure adequate fire extinguishers, water barrels, or other fire-fighting equipment is located onsite. Extinguishers shall be on hand wherever welding or cutting is being accomplished, with the use of flammables and other special hazards.
 - 3.5. **HOUSEKEEPING.** Daily clean-up of all debris and waste materials is required. Adequate disposal containers should be placed strategically around the site. Debris shall be removed on a daily basis.
 - 3.6. **MECHANICAL EQUIPMENT INSPECTION.** All mechanical equipment (trucks, cranes, forklifts, backhoes, graders, etc.) shall be inspected prior to its use and daily throughout the life of the contract.
 - 3.7. **FIRST AID AND MEDICAL.** First aid facilities shall be made available on the job site. Arrangements for emergency medical attention shall be made prior to start of work. All emergency numbers (doctor, hospital, ambulance, fire department) shall be posted at the project superintendent's office. Field personnel shall have radio contact with a constantly manned station where these numbers are posted.
 - 3.8. **SANITATION FACILITIES.** Sufficient numbers of toilet facilities as specified in para. 03.B of EM 385-1-1 shall be provided. Portable chemical are authorized. Insure safe drinking water and individual cups are available. For the projects where corrosive or toxic materials are used, separate washing facilities are required.
 - 3.9. **SAFETY PROMOTION.** The Contractor shall promote accident prevention by use of one or more of the following: posters, display materials, safety contests, awards programs and similar items.
 - 3.10. **ACCIDENT REPORTING.** All accidents (employee injuries, vehicle, building, or equipment property damage), regardless of their severity, shall be reported to the onsite Government Representative or to the Area Engineer. The Contractor will be notified of the forms to be submitted.
 - 3.11. **PHASE SAFETY PLANNING.** Before each phase of work begins, a phase plan listing the possible hazards that might be expected while accomplishing that phase of work and the procedures to be used to overcome or eliminate the hazards of that phase will be discussed between the Contractor and the onsite Government Representative. A phase is defined as an operation involving a type of work which presents hazards not experienced in previous operations or where new subcontractors are performing the work (i.e., earth moving, trenching, concrete work, roofing, electrical, masonry). The onsite Government Representative will determine the format and amount of detail required of the written plan. The amount of detail will be determined by the complexity of that phase of work.
4. **SPECIAL SAFETY REQUIREMENTS OF POST, BASE, OR PLANT.** Comply with provision of past safety and operations plans.
 5. **CONTRACTOR SAFETY PERSONNEL REQUIREMENTS (1985 JAN HQ USACE).**
 - 5.1. **GENERAL.** The Contractor shall employ at the project site, to cover all hours of work, at least one Safety and Occupational Health (SOH) person to manage the Contractor's accident prevention program. This individual may be the same as the Quality Control Staff C.I.H. identified in Section 01100; 14.6.4. Duties which are not germane to the safety program shall not be assigned to the SOH person(s). The principal safety person shall report to and work directly for the Contractor's onsite top manager, higher level official, or corporate safety office. The SOH person(s) shall have the authority to take immediate steps to correct unsafe or

unhealthful conditions. The presence of a SOH person will not abrogate safety responsibilities of other personnel. The Contractor shall submit names and qualifications of the nominated SOH person(s) to the Contracting Officer for acceptability and a functional description of duties shall be provided prior to the preconstruction conference.

- 5.2. **QUALIFICATIONS FOR SOH PERSON(S).** The Contractor's SOH person(s) shall be required to have one of the following experience and/or education qualifications:
- 5.2.1. A degree in engineering or safety in at least a 4-year program from an accredited school; or
 - 5.2.2. A legal registration as a professional engineer or a certified safety person and, in addition, shall have been engaged in safety and occupational health for at least one (1) year of experience, of which no less than fifty (50) percent of the time was devoted to safety and occupational health; or
 - 5.2.3. A degree other than that specified above and, in addition, shall have been engaged in safety and occupational health for at least three (3) years of which no less than fifty (50) percent of the time each year was devoted to safety and occupational health; or
 - 5.2.4. Qualified experience in safety and occupational health for at least five (5) years of which no less than fifty (50) percent of the time each year was devoted to safety and occupational health.
 - 5.2.5. In any of the above, first aid work shall not be considered as creditable experience (based on EFARS 52.2/9303).

INTERIM CHANGE TO EM 385-1-1 - SAFETY AND HEALTH REQUIREMENTS MANUAL

1. Page 21, Section 07.A.03, replace with the following:

"07.A.03 - Protective footwear, such as rubber boots, protective covers, ice clamp-ons, and steel-toed safety boots, shall be worn by all persons exposed to hazards to the feet (including, but not limited to impact, puncture, slipping, electrical, or chemical hazards).

 - a. For all activities in which Corps or contractor personnel or official visitors are potentially exposed to foot hazards, the applicable job/activity hazard analysis, accident prevention plan, or project safety plan shall include an analysis of, and prescribe specific protective measures to be enforced for, foot hazards.
 - b. Footwear providing protection against impact and compressive forces, conduction hazards, electrical hazards, and sole puncture shall meet the applicable requirements of ANSI Z41."
2. Page 143, Section 18.C.05, replace with the following.

"18.C.05 - All load drums on loading-hoisting equipment shall be equipped with at least one positive holding device. This device should be applied directly to the motor shaft or some part of the gear train. It is not necessary that the positive holding device utilize shearing of metal to meet this requirement. Friction surfaces are acceptable."
3. Page 145, add Sections 18.C.24 and 18.C.25 which will read:

"18.C.24 - During personnel handling operations load and boom hoist drum brakes, swing brakes, and locking devices such as pawls or dogs shall be engaged when the occupied platform is in a stationary working position.

"18.C.25 - During personnel handling operations the load hoist drum shall have a system or device on the power train other than the load hoist brake, which regulates the lowering rate of speed of the hoist mechanism (controlled load lowering). Free fall is prohibited."

4. Page 146, Section 18.D.09, replace with the following:

"18.D.09 - All telescopic boom cranes engaged in standard lift operations (including concrete bucket) should be equipped with a two-block warning feature(s), a two-block damage prevention feature, or an anti-two block device for all points of two-blocking (i.e., jibs, extension, etc). In addition, all new telescopic boom cranes shall be equipped with an anti-two block device or a two-block damage prevention feature for all points of two-blocking. Cranes that are used exclusively as duty cycle machines (clamshell, dragline, grapple, pile driving operations) are exempt from this requirement but will meet the requirements of ANSI/ASME-B30.5-1982 (as revised). To alleviate difficulties associated with attaining compliance, an implementation time period until 1 January 1991 is granted. In all cases where cranes are utilized without these safeguards equivalent protection shall be established, documented and approved by the designated authority."

5. Page 146, add Sections 18.D.10 and 18.D.11, which will read:

"18.D.10 - All lattice boom cranes engaged in standard lift crane operations (including concrete bucket) shall be equipped with a two-block warning feature which functions for all points of two-blocking. Cranes that are used exclusively as duty cycle machines (clamshell, dragline, grapple, pile driving operations) are exempt from this requirement but will meet the requirements of ANSI/ASME-B30.5-1982 (as revised). To alleviate difficulties associated with attaining compliance, an implementation time period until 1 January 1991 is granted. In all cases where cranes are utilized without these safeguards equivalent protection shall be established and documented and then approved by the designated authority."

"18.D.11 - During personnel handling operations all telescopic and lattice boom cranes shall be equipped with a device which when activated disengages all functions whose movement can cause contact between the load block or overhaul ball and the boom tip (anti-two block device), or a system shall be used which deactivates the hoisting action before damage occurs in the event of a two-blocking situation (two-block damage prevention feature). The device or system must be installed for all points of two-blocking (i.e. jib or boom points) and in the case of the anti-two block device the crane must be equipped with automatic brakes on each hoist line; hoist lines not so equipped must be taken out of service while personnel lifts are being made."

6. **HEALTH AND SAFETY PLAN.** The contractor shall develop and implement a Health and Safety Plan (HASP) to cover at a minimum the following information:

6.1. **SCOPE.** This section describes the minimum safety, health and emergency response requirements for the performance of work under this contract. These requirements are in addition to those in CONTRACT CLAUSES clause: "Accident Prevention" and USAGE Safety and Health Requirements Manual EM 385-1-1.

6.2. **PRECONSTRUCTION CONFERENCE.** A preconstruction conference will be scheduled prior to beginning of site work at which time representatives of the Contracting Officer will review and discuss requirements relative to planning and administration of the overall safety program.

6.3. **REGULATORY REQUIREMENTS AND APPLICABLE PUBLICATIONS.** The site specific safety and health provisions implemented on this site shall be consistent with the requirements outlined below. In the case that these requirements are conflicting, the one which offers the greatest degree of protection shall be followed.

6.3.1. Federal Acquisitions Regulation (FAR), clause 52.236-13.

6.3.2. Occupational Safety and Health Administration (OSHA) General Industry standards found in Title 29 Code of Federal Regulations Part 1910. The Contractor is made especially aware of the requirements found at 29 CFR 1910.120.

- 6.3.3. OSHA Construction Industry Standards found in Title 29 CFR Part 1926.
- 6.3.4. U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, revised October 1987.
- 6.3.5. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values and Biological Exposure Indices, current edition.
- 6.3.6. NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985, DHHS (NIOSH) Publication No. 85-115.
- 6.4. **SITE CHARACTERIZATION.** Surface soils in the excavated area have not been identified as contaminated by Remedial Investigation/Feasibility Studies conducted at the Arsenal. The proposed excavation will cross a contaminated sewer that has been removed. The HASP shall require that soils within 10 lateral feet of the sewer be tested for volatile materials and make provisions for upgrading personal protection and decontaminating equipment should contaminants be encountered.
- 6.5. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit the following items required by this section:
 - 6.5.1. **CATEGORY I.**
 - 6.5.1.1. Site-specific Safety and Health Plan (SSHP).
 - 6.5.2. **CATEGORY II.**
 - 6.5.2.1. For approval.
 - 6.5.2.1.1. Name and qualifications of the Site Safety and Health Officer.
 - 6.5.2.2. For information only.
 - 6.5.2.2.1. Training Logs.
 - 6.5.2.2.2. Weekly Safety Reports.
 - 6.5.2.2.3. Closeout Safety Report.
 - 6.5.2.2.4. Accident Reports.
 - 6.5.2.2.5. Air Monitoring Results.
 - 6.5.2.2.6. Heat/Cold Stress Monitoring Results.
 - 6.5.2.2.7. Instrument Calibration/Maintenance Records.
- 6.6. **GENERAL REQUIREMENTS FOR PLAN PREPARATION AND IMPLEMENTATION.**
 - 6.6.1. **PLAN PREPARATION.** In accordance with the requirements of OSHA standard 29 CFR 1910, the Contractor shall maintain a written Safety and Health Program. As part of this program, the Contractor shall prepare a Site-specific Safety and Health Plan (HASP). This plan shall establish, in detail, the protocols necessary for the recognition, evaluation, and control of all hazards associated with each task performed by the Contractor. Fourteen (14) days after receipt of Notice to Proceed, the HASP shall be submitted to the Contracting Officer for review and approval. On-site activities shall not commence until the Contractor has received formal approval of the HASP from the Contracting Officer.

6.6.2. The HASP shall meet all the requirements of 29 CRF 1910.120 and shall address, at a minimum, the topics listed below. Where the use of a specific topic is not applicable, it shall be so noted in the plan, and a brief justification made.

- 6.6.2.1. Staff organization, qualifications, and responsibilities.
- 6.6.2.2. Hazard assessment and risk analysis, including accident prevention.
- 6.6.2.3. Employee Training.
- 6.6.2.4. Personal protective equipment for each task and operation.
- 6.6.2.5. Medical Surveillance.
- 6.6.2.6. Exposure Monitoring, Environmental Sampling.
- 6.6.2.7. Site Control.
- 6.6.2.8. Decontamination.
- 6.6.2.9. Site's Standard Operating Procedures.
- 6.6.2.10. Emergency Response Plan.
- 6.6.2.11. Confined Space Entry Procedures.
- 6.6.2.12. Spill Containment Program.
- 6.6.2.13. Logs, Reports, and Recordkeeping.

6.6.3. PLAN IMPLEMENTATION.

- 6.6.3.1. Should any unforeseen safety-related hazard become evident during the performance of the work, the Contractor shall bring such hazard to the attention of the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, the Contractor shall take necessary action to reestablish and maintain safe working conditions in order to safeguard on-site personnel, visitors, the public, and the environment.
- 6.6.3.2. Should the Contractor seek modification of any portion or provision of the SSHP, such modification shall be requested by the Contractor in writing and, if approved, shall be authorized in writing by the Contracting Officer.

8. SPECIFIC REQUIREMENTS.

- 8.1. **ON-SITE PERSONNEL.** The Contractor shall identify an individual, known as the Site Safety and Health Officer (SSHO), who shall have a working knowledge of pertinent Federal and State safety and health regulations and be knowledgeable in monitoring procedures and protocol required by this project. The SSHO shall hold current certification in first aid and cardiopulmonary resuscitation (CPR) from a recognized organization such as the American Red Cross.
- 8.2. **HAZARD ASSESSMENT AND RISK ANALYSIS.** The Contractor shall identify expected hazards and risks for each site task and operation. Accident prevention, as discussed in paragraphs 01.A.03 through 01.A.06 and Appendix Y of USACE EM 835-1-1, shall be addressed for those topics not specifically covered elsewhere in the SSHP. Requirements for accident prevention and phase plans are listed in the Omaha District Guide outlines entitled: "Guide Outline for Accident Prevention Proposal" and "Phase Plan Guidelines." Copies of these outlines

will be furnished the Contractor and are available to prospective bidders and others from the local Area Office or from:

Safety and Occupational Health Office
Attn: CEMRO-SO
U.S. Army Engineer District, Omaha
215 North 17th Street
Omaha, Nebraska 68102-4978

The Contractor shall review these guide outlines and ensure that all elements are adequately addressed in the SSHP. Some elements will be addressed elsewhere, there is no need to duplicate information.

- 8.3. TRAINING.** Contractor personnel shall be trained in accordance with the requirements of 29 CFR 191^r 120.
- 8.4. PERSONAL PROTECTIVE EQUIPMENT.** The Contractor shall provide all on-site personnel with appropriate personal safety equipment and protective clothing, and shall ensure that all safety equipment and protective clothing is kept clean and well maintained. All requirements of USACE EM 385-1-1 and OSHA standards 29 CFR 1910 and 1926 must be followed.
- 8.5. MEDICAL SURVEILLANCE.** Medical surveillance for Contractor personnel shall be in accordance with the requirements of 29 CFR 1910.120.
- 8.6. EXPOSURE MONITORING AND AIR SAMPLING.** The Contractor shall delineate appropriate exposure monitoring and air sampling procedures and associated action levels in the SSHP.
- 8.6.1. Direct Reading.**
- 8.6.1.1. Contaminated Sewer Excavation.** The contaminated sewer excavation zone has the potential of releasing volatile organic vapors associated with the ground-water contamination beneath the site. Because of this potential, the Contractor shall perform air monitoring during excavation of the zone. Monitoring shall be performed with a direct reading instrument capable of detecting organic vapors including those previously identified in the ground water. The purpose of the monitoring shall be to ensure that workers are not exposed to any substances above regulatory limits.
- 8.6.1.2. Confined Space Entry.** Any entry into a confined space shall include monitoring with direct reading instruments following, at a minimum, requirements in EM 385-1-1, Section 27.
- 8.6.2. Monitoring of High Risk Employees.** The Contractor shall monitor high risk employees in accordance with 29 CFR 1910.120(h)(4).
- 8.6.3. Heat and Cold Stress Monitoring.** The Contractor shall monitor all personnel to note for signs of heat or cold stress, as dictated by weather conditions. In addition, all field personnel shall be instructed to observe for symptoms of heat or cold stress and methods on how to control it.
- 8.7. SITE CONTROL.** The Contractor shall institute appropriate site control procedures in accordance with 29 CFR 1910.120d.
- 8.8. DECONTAMINATION.** The Contractor shall institute appropriate decontamination procedures in accordance with 29 CFR 1910.120(k). At a minimum, personnel shall be required to wash their hands and face before eating, drinking, smoking, or leaving the work area.

8.9. STANDARD OPERATING PROCEDURES. The HASP shall address the standard operating safety procedures, engineering controls and safety work practices to be implemented for the work under this contract.

8.9.1. Excavation. All excavations shall be conducted in strict conformance, with at a minimum, Section 23 of EM 385-1-1 and 29 CFR 1926.650 through 1926.653. Recent water level measurements in the zone indicated the water table is below the depth of the excavation as shown on the drawings. If excavation of soil uncovers potentially hazardous munitions, munitions components or other hazardous materials or if ground water is contacted during the zone excavation, the Contractor shall cease operations and immediately contact the Contracting Officer for further instructions. Upon written approval from the Contracting Officer, the Contractor shall provide all necessary work to remove the hazard in accordance with the Contracting Officer, Rocky Mountain Arsenal procedures/policies, and as provided in the contract clause title "Changes."

8.9.2. EMERGENCY RESPONSE PLAN. The Contractor shall develop an emergency response and contingency plan in accordance with 29 CFR 1910.120(1). The plan shall also address and comply with special Rocky Mountain Arsenal procedures/policies listed below and included at the end of this section.

8.9.2.1. Letter dated 11 March 1986, "Command Policy - Control of Suspected Munitions or Other Hazardous Material Found on Post."

8.9.2.2. Standing Operating Procedure No. GC-01, "Emergency Notification Plan, Rocky Mountain Arsenal."

8.9.3. CONFINED SPACE ENTRY. The Contractor shall comply with the requirements for confined space entry in EM 385-1-1, Section 27.

8.9.4. LOGS, REPORTS AND RECORDKEEPING. The Contractor shall maintain logs and reports covering the implementation of the HASP. The formats shall be developed by the Contractor.

9. SAFETY MEETINGS. The Contractor shall conduct periodic safety meetings in accordance with 29 CFR 1910.120(b) and EM 385-1-1.

10. SAFETY INSPECTIONS. The Contractor shall conduct inspections to determine the effectiveness of the SSHP. See paragraph: Safety Inspections, in SECTION: SPECIAL CLAUSES.

11. MEASUREMENT AND PAYMENT. No separate measurement will be made for the work covered in this section and all costs of performing the work shall be included in the applicable contract lump sum price for the "Safety, Health, and Emergency Response Requirements" complete as shown on the drawings and as specified herein.

12. RADIOLOGICAL EQUIPMENT. All radioactive equipment brought onto the site shall be covered by specific provisions of the HASP.

ZERO ACCIDENTS

SECTION 02221 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES

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PART 1 - GENERAL

1. **APPLICABLE PUBLICATIONS.** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
 - 1.1. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.**

D 1556-82	Density of Soil In Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 kg) Rammer and 18-inch (457 mm) Drop
D 2487-85	Classification of Soils for Engineering Purposes
D 2922-81	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017-78	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
E 548-84	Preparation of Criteria for Use in Evaluation of Testing Laboratories and Inspection Bodies
2. **DEFINITIONS.**
 - 2.1. **SUITABLE MATERIALS.** Suitable materials shall consist of any material not included in the unsuitable materials definition.
 - 2.2. **UNSUITABLE MATERIALS.** Unsuitable materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 3 inches, and materials classified in ASTM D 2487 as MH, PT, OH, and OL. Unsuitable materials also include landfills, refuse, contaminated soil, or debris from previous construction as determined by the Contracting Officer, otherwise suitable material which is unsuitable due to excess moisture content will not be classified as unsuitable material unless it cannot be dried by manipulation, aeration, or blending with other materials.
 - 2.3. **COHESIONLESS AND COHESIVE MATERIALS.** Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.
 - 2.4. **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 not contain more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve, with a maximum allowable aggregate size of 1 inch or the maximum size recommended by the pipe manufacturer, whichever is smaller, unless otherwise specified.

- 2.5. **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 1557.

PART 2 - EXECUTION

3. **EXCAVATION.** Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides or cave-ins. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsuitable excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material, if directed, shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost to the Government. Excavated material not required or not satisfactory for backfill shall be disposed of in waste areas as directed by the Contract Officer. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained. Unauthorized over excavation shall be backfilled in accordance with paragraph BACKFILLING at no additional cost to the Government.
- 3.1. **TRENCH EXCAVATION.** The trench below the top of the pipe shall not be excavated wider than the outside diameter of the pipe plus 24 inches for pipes of less than 24 inch inside diameter and no wider than the outside diameter of the pipe plus 36 inches for larger sizes. Where trench widths are exceeded, redesign using stronger pipe or special installation procedures shall 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. Trench walls below the top of the pipe shall be vertical. Trench walls above the top of pipe may be sloped or widened as necessary for the proper safe performance of the work.
- 3.1.1. **Bottom Preparation.** Trench bottoms shall be over excavated to allow the installation of granular bedding as detailed on the drawings.
- 3.1.2. **Removal of Unsuitable Material.** Where unsuitable 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 select granular material as provided in paragraph BACKFILLING. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.
- 3.1.3. **Special Excavation in Contaminated Soils.**
- 3.1.3.1. **Excavation for pipeline** must cross an identified chemical waste line which has been removed and is identified on plans. This waste line, although removed, is still a potentially contaminated site. 10' on each side of crossing the soil shall be tested as indicated in 3.1.3.2. Should contaminated soils be encountered, all personnel on site will be required to have 40 hours Health and Safety training as set forth in Section 01400.
- 3.1.3.2. **Excavation in contaminated soil area** shall be performed as follows:
1. Excavate soil, using machinery, one bucket at a time.
 2. Analyze each bucket with an Organic Vapor Analyzer monitor and an HNu photoionization detector and determine if soil is contaminated. Any reading on either instrument above background on 3 consecutive buckets will be considered contaminated.

3. If soil is contaminated, the contaminated soil shall be removed and placed in drums which will be provided by the government. The excavated trench shall be then be filled and compacted with select or sand material as specified in paragraph: BACKFILLING.
 4. If soil is not contaminated, stockpile spoil and use for backfill.
 5. At end of each shift, decontaminate equipment and drum waste for disposal by government. Refer to the site Health and Safety Plan for personnel protection requirements. This procedure is to be included in the contractor's HASP.
 6. If contaminated soils are encountered during excavation, the contractor shall remove and replace with uncontaminated material. The contractor shall be reimbursed for cubic yards of contaminated soil removed. Replacement with uncontaminated material shall be considered an incidental cost in the contaminated material removal.
- 3.2. **EXCAVATION FOR APPURTENANCES.** Excavation for manholes 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 and to allow the placement of any required precast concrete element and pipe fittings. Removal of unsuitable 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.
- 3.3. **SURFACE WATER.** Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches. Existing drainage facilities may be used for disposal of surface water subject to prior approval of the Contracting Officer. The Contractor shall be responsible for all damages incurred to the drainage facilities as a result of the operations. All pipes or conduits shall be left clean and free of sediment. The contractor shall contact the Contracting Officer if any water is encountered in the trench.
- 3.4. **SHEETING AND SHORING.** Except where banks are cut back on a stable slope, excavation for structures and trenches shall be sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances.
4. **BACKFILLING AND REPLACEMENT.** Backfill material shall consist of suitable material. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors. Each layer shall be compacted to at least 95 percent maximum density obtained as measured by the Standard Proctor Density.
- 4.1. **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 test. The joints and couplings shall be left uncovered during the pressure test.
- 4.1.1. **Not Used.**
 - 4.1.2. **Replacement of Unsuitable Material.** Unsuitable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.
 - 4.1.3. **Bedding.** Bedding shall conform to the details shown on the drawings and specified below. Material shall be deposited in 6 inch loose layers and compacted with approved methods to at least 95 percent maximum density. Care shall be taken to ensure

thorough compaction of the fill under the pipe haunches. Bedding shall consist of select granular material.

4.1.3.1. **Class A Bedding.** Class A bedding is not required unless improper trenching or unexpected trench conditions require its use.

4.1.3.2. **Class B Bedding.** Class B bedding shall be used for all gravity sewer lines.

4.1.3.3. **Sand Bedding.** Sand bedding shall be used for all pressure pipe.

4.1.4. **Initial Backfill** shall consist of suitable materials with a maximum stone size not exceeding the limits shown on the drawings. Initial backfill shall be placed in 6-inch loose thickness layers and compacted to at least 90 percent of maximum density at moisture contents that will facilitate compaction in granular materials and shall be within ± 2 percent of optimum for all other materials. Initial backfill shall be placed to a height of at least 1 foot above the top of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

4.1.5. **Final Backfill.** The remainder of the trench, except for special materials for roadways and railroads shall be backfilled with suitable material. Backfill material shall be deposited and compacted as follows:

4.1.5.1. **Roadways, Parking Lots, and Railroads.** Backfill shall be placed up to the elevation of the base course in 6-inch layers and compacted to 98 percent maximum density. Base course shall be compacted to 98 percent maximum density. Pavement shall conform to PARAGRAPH: PAVEMENT AND WALK REMOVAL AND REPLACEMENT. Water flooding or jetting methods of compaction will not be permitted.

4.1.6. **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 90 percent maximum 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.

4.2. **BACKFILL FOR APPURTENANCES.** After the manhole or similar structure has been constructed and has been allowed to cure for a minimum of 7 days, or earlier if test cylinders indicate that strength has been reached, 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 placed in such a manner as to prevent eccentric loading and excessive stress on the structure.

5. **SPECIAL REQUIREMENTS.** Special requirements for both excavation and backfill relating to the specific utilities are as follows:

5.1. **WATER AND SEWER LINES.** Trenches shall be of a depth to provide a minimum cover of 5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

5.2. **ELECTRIC LINES.** Power service to the pump station and all other electric services shall be buried a minimum of 18" from the final ground surface. The decision as to overhead or buried electric lines is to be made by the Army, who will be doing the electrical power work.

5.3. **PLASTIC MARKING TAPE.** Warning tape shall be of the type specifically manufactured for marking and locating underground utilities. The tape shall be installed directly above the pipe, at a depth of 24 inches below finished grade unless otherwise shown. The tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elonga-

tion factor of 350 percent. 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
Green:	Sewer Systems

Tape for all nonmetallic utility lines shall have 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 metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion.

6. **TESTING.** Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.
 - 6.1. **DETERMINATION OF DENSITY.** Density tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. Approval of testing facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained for each lift. One test shall be made for every 250 linear feet of installation, except areas to receive pavements, for which two tests shall be made for each crossing. Laboratory tests for moisture-density relations shall be determined in accordance with ASTM D 1557, Method B, C, or D. A mechanical tamper may be used, provided the results are correlated with those obtained by the referenced hand tamper. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in paragraph "Calibration" of ASTM D 2922. 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 gages shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. If ASTM D 2922 is used for field density control, there should be at least one test performed according to ASTM D 1556 per every ten tests performed according to ASTM D 2922 for correlation of test results. Copies of calibration curves and results of calibration tests shall be furnished to the Contracting Officer within 24 hours of conclusion of the tests. 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. Documentation of compaction testing shall be delivered to the Contracting Officer prior to processing with next project phase.
 - 6.2. **DISPLACEMENT OF SEWERS.** After other required tests have been performed and the trench backfill compacted to 3 feet above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. The pipes shall be inspected by shining a light or laser between manholes or manhole locations, or by use of television cameras passed through the pipe. If, in the judgment 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.
7. **PAVEMENT AND WALK REMOVAL AND REPLACEMENT.**
 - 7.1. **FLEXIBLE PAVEMENT.** Where construction requires cutting and replacing of flexible pavement, cutting shall be so accomplished that the remaining exposed edges shall conform vertically and horizontally to a straight line. The full depth of surface and binder course shall be removed to a width of 10 feet with a saw cut on the edges. Base course shall be removed to a point 1 foot back from each side of the trench. The replaced pavement shall match the

existing in section and depth and shall conform to SECTION: BITUMINOUS INTERMEDIATE AND SURFACE COURSES, and SECTION: CRUSHED AGGREGATE BASE COURSE. Concrete curb and gutter shall be removed to the nearest joint. Saw cutting to a minimum depth of 1 inch will be permitted if the remaining section to the next joint is 4 feet or more. Replaced section shall match the adjacent curb and gutter and shall be 4000 psi concrete, air-entrained track washout and shall conform to Section: CONCRETE. Truck washout to be done off-base.

ZERO ACCIDENTS

SECTION 02241
CRUSHED AGGREGATE BASE COURSE

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

1.1. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS.**

- | | |
|----------------------|--|
| C 88-83 | Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| C 117-84 | Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| C 131-81 | Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| C 136-84 | Sieve Analysis of Fine and Coarse Aggregates |
| D 75-87 | Sampling Aggregates |
| D 422-63
(R 1972) | Particle-Size Analysis of Soils |
| D 1556-82 | Density of Soil In-Place by the Sand Cone Method |
| D 1557-78 | Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18-inch Drop |
| D 2922-81 | Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| D 3017-78 | Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth) |
| D 4318-84 | Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| E 11-81 | Wire-Cloth Sieves for Testing Purposes |

1.2. **U. S. ARMY CORPS OF ENGINEERS HANDBOOK FOR CONCRETE AND CEMENT.**

- CRD-C 130-79 Scratch Hardness of Coarse Aggregate Particles

2. **EQUIPMENT.** All plant, equipment, tools and machines used in the performance of the work shall be subject to approval prior to commencement of work. This equipment shall be maintained in satisfactory working condition at all times.

3. **APPROVAL, SAMPLING, AND TESTING.** Sampling and testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. Tests shall be performed at the frequency specified hereinafter. Copies of test results shall be furnished to the Contracting Officer as soon as tests are performed and in every case prior to placing subsequent construction over completed base course.
- 3.1. **GENERAL.** The Contractor shall select the source of materials and perform initial sampling and testing sufficiently in advance to not delay the work. The Contractor shall control his operations during production and placement of material, so that materials in the completed course will meet specified requirements. All quality control sampling and testing shall be performed by the Contractor in accordance with paragraph: CONTRACTOR QUALITY CONTROL in SECTION: SPECIAL CLAUSES, and as specified herein. The Government may perform verification tests for final approval of materials in the completed course.
- 3.2. **SAMPLES.** All samples including those required and used by the Contractor for control of his operations, shall be representative of materials being placed. In addition, samples shall be taken from completed and compacted course. All samples shall be taken in conformance with ASTM D 75 unless otherwise approved or directed.
- 3.3. **TESTS.** The following tests shall be performed by the Contractor.
- 3.3.1. **Sieve Analyses** shall be made in accordance with ASTM C 117, C 136, and D 422. Sieves shall conform to ASTM E 11.
- 3.3.2. **Wear (L.A. Abrasion) Test** shall be made in conformance with ASTM C 131.
- 3.3.3. **Soundness** shall be determined in accordance with ASTM Standard C 88 using magnesium sulfate.
- 3.3.4. **Liquid-Limit and Plasticity-Index** shall be determined in accordance with ASTM D 4318.
- 3.3.5. **Moisture-Density Determinations.** The maximum density and optimum moisture shall be determined in accordance with ASTM D 1557, Method D.
- 3.3.6. **Field Density.** 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. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil. 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 gages shall also be checked along with density calibration checks as described in ASTM D 3017. Calibration curves for the moisture gages as specified in ASTM D 3017 and for density gages as specified in ASTM D 2922 shall be furnished. The calibration curves for the moisture gages and density gages shall be checked at the beginning of the job and on each type of material encountered on the job. If nuclear devices are used, not less than 1 of every 10 consecutive field density tests shall be in accordance with ASTM D 1556 to provide correlation. Calibration curves, test results, and correlation tests shall be furnished within 24 hours of the conclusion of the tests. At least one field density test shall be performed for each 1,000 square yards of each layer of base material.
- 3.3.7. **Crushed Particles** shall be determined by visual examination and measurement.
- 3.3.8. **Degree of Compaction** required under the paragraph: COMPACTION is expressed as a percentage of the maximum density obtained by the test procedure in ASTM D 1557, Method D. This will be abbreviated hereinafter as percent laboratory maximum density.

3.4. TESTING FREQUENCY.

3.4.1. 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 will meet all specified requirements when furnished and after placing and compaction.

Sieve Analysis including 0.02 mm size material

L.A. Abrasion

Particle Shape

Crushed Particles, unless material is crushed quarried rock

Soundness

Liquid-Limit and Plasticity-Index

Moisture-Density Relationship

3.4.2. In-Place Tests. One of each of the following tests shall be performed on samples taken from the placed and compacted base course. Samples shall be taken for each 1,000 square yards of each layer of material placed in each area.

Sieve Analysis including 0.02mm size material

Field Density and Moisture

Liquid Limit and Plasticity Index

Crushed Particles, unless the material is crushed quarried rock or unless otherwise approved

4. SUBMITTALS. In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit data as specified herein on the following:

4.1. CATEGORY I. None.

4.2. CATEGORY II. (For Information Only)

Initial test results on proposed material (Para. 3.4.1)

In-place tests (Para. 3.4.2)

5. WEATHER LIMITATIONS. Courses shall be constructed only when atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F., the Contractor shall protect, by approved methods, all areas of completed or partially completed crushed aggregate base course against freezing.

6. STOCKPILING MATERIAL. Prior to stockpiling of material, storage sites shall be cleared and leveled. Aggregates shall be stockpiled on designated cleared and leveled areas so as to prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

7. AGGREGATES. Aggregates shall consist of crushed stone, crushed gravel, angular sand or other approved sound, durable materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from foreign materials such as organic matter, lumps of clay and coatings.

Disintegrated granite shall not be used for production of any aggregate and the processed aggregate shall contain not more than 2.0 percent by weight of disintegrated granite particles in that portion of the total sample larger than the No. 4 sieve and not more than 4.0 percent in any individual sieve size listed in the required aggregate gradation for that portion larger than the No. 4 sieve. A disintegrated granite particle is defined as a soft, crumbly particle of igneous rock having a visible crystalline grain size and consisting essentially of feldspar and quartz with lesser amounts of micas and/or amphiboles and pyroxenes. Generally, the rock particle will be stained by iron oxide and the feldspar grains will have a dull, highly fractured appearance. The individual mineral grains are so weakly bonded that the particle will crumble under moderate pressure. When tested by Test Method CRD-C 130 the particle would be classified as soft. The Contractor shall obtain materials that meet the requirements specified herein and that can be constructed to meet the gradation, compaction and smoothness requirements specified herein after placement. The material retained on a No. 4 sieve shall be known as coarse aggregate; that passing the No. 4 sieve shall be known as binder material.

7.1. **COARSE AGGREGATE** conforming to the requirements specified above shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested in accordance with ASTM C 131. When subjected to 5 cycles of the soundness test, in accordance with ASTM Standard C 88 using magnesium sulfate, the loss in weight of coarse aggregate shall not exceed 18 percent. Coarse aggregate shall consist of crushed rock or crushed gravel having angular fragments uniform in density and quality. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3, and an elongated particle is one having a ratio of length to width greater than 3. Crushed gravel shall conform to the requirements of Crushed Gravel or Coarse Aggregate below. The Contractor shall notify the Contracting Officer in writing stating which subparagraphs the crushed gravel shall conform to, and the selected paragraph requirements shall be mandatory for the entire job.

7.1.1. **Crushed Gravel** shall be manufactured from gravel particles 50 percent of which by weight are retained on the maximum size sieve listed in GRADATION below.

7.1.2. **Crushed Stone** retained on each sieve specified shall contain at least 50 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 piece. When two fractures are adjacent, the angle between the planes of the fractures must be at least 30 degrees to count as two fractured faces.

7.2. **BINDER MATERIAL** shall consist of screenings, angular sand or other finely divided mineral matter processed or naturally combined with the coarse aggregate. The portion of any component, or 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.

7.3. **GRADATION** requirements shall apply to the completed base. The maximum size of aggregate shall be not over 1 1/4 inches and the material shall be well graded within the limits specified below. The Contractor shall designate one of the following gradations for use on the project and all the material furnished for the project shall conform to the designated gradations after placement and compaction.

Sieve Designation	Percentage by Weight Passing Square-Mesh Sieve		
	No. 1	No. 2	No. 3
2 inches	100	-	-
1-1/2 inch	70-100	100	-
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70

Sieve Designation	Percentage by No. 1	Weight Passing No. 2	Square-Mesh Sieve No. 3
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	0-8	0-8	0-8
0.02 mm	0-3	0-3	0-3

The above gradations represent the extreme limits which shall determine suitability of aggregate for use from all sources of supply. The aggregate used in the work shall have a gradation within the limits designated in the table, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but shall be well graded from coarse to fine.

8. CONSTRUCTION.

- 8.1. **GRADE CONTROL.** During construction the lines and grades including crown and cross slope indicated shall be maintained by means of line and grade stakes placed by the Contractor in accordance with SPECIAL CLAUSES.
- 8.2. **OPERATION OF PITS OR QUARRIES.** All work involved in the clearing, stripping, and excavating in opening or operation of pits or quarries shall be performed by the Contractor. *There are no pits or quarries on Government land. Pits or quarries on private lands shall be conditioned in agreement with local laws and authorities.*
- 8.3. **PREPARATION OF SUBGRADE.** Prior to constructing crushed aggregate base course, the subgrade shall be cleaned of all foreign substances. Ruts or soft, yielding spots in the subgrade areas having inadequate compaction, and deviations of the surface from requirements set forth therein shall be corrected to specification requirements prior to placing the base course. *The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained by Contractor in a satisfactory condition until base course is placed.*
- 8.4. **MIXING AND PLACING.** Materials shall be mixed by the stationary-plant, traveling-plant, or road-mix method and placed in such a manner as to obtain uniformity of the crushed aggregate base course material and at a uniform optimum water content for compaction. Contractor shall make such adjustments in mixing or placing procedures or in equipment to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory base course.
- 8.5. **COMPACTION.** Each layer of crushed aggregate base course including shoulders shall be compacted. Water content shall be maintained at optimum. Density of compacted mixture shall be at least 100 percent of laboratory maximum density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. Areas inaccessible to the rollers shall be compacted with mechanical tampers, and shall be shaped and finished by hand methods.
- 8.6. **LAYER THICKNESS.** The compacted thickness of the crushed aggregate base course shall be as indicated. When a compacted layer of 6 inches or less is specified, the material shall be placed in a single layer. When a compacted thickness of more than 6 inches is required, no single layer of the placed material shall be in excess of 8 inches nor less than 3 inches when compacted.
- 8.7. **EDGES OF THE BASE COURSE.** The manner of construction and the type of edge required for the base course will depend on the type of road section and the adjacent construction. The following edges shall be used at the locations shown on the drawings or designated by the typical pavement section.

- 8.7.1. **With Curb and Gutter (Without Subdrains).** Where the pavement section includes concrete curb and gutter, the base course under the curb and gutter shall terminate in a vertical edge at the back of the curb and gutter. Approved material from excavation or borrow, as required, shall be placed along the vertical edge in such quantity as will compact to the thickness of the base course being constructed. The approved material shall be not less than three (3) feet in width and shall be rolled and compacted simultaneously with each layer of the base course.
- 8.7.2. **With Concrete Straight Curb.** Where the pavement section includes concrete straight curb, the base course which is below the bottom of the concrete straight curb shall be constructed as specified above for concrete curb and gutter consistent with the requirement of a minimum layer of 3-inch compacted thickness. The concrete straight curb shall then be constructed and backfilled prior to the construction of the balance of the base course. Care shall be exercised to preclude damaging the concrete or disturbing the grade of the completed concrete straight curb.
- 8.7.3. **With Shoulders.** Where the pavement section includes shoulders constructed of base course, the base course portion of the shoulders shall be constructed in the same manner and simultaneously with the base course under the surfacing. All requirements for the base course shall apply to the shoulders. The tapered edge of the shoulders shall be constructed in such manner as the Contractor elects subject to the approval of the Contracting Officer, but the finished surface of the shoulders and tapered edges shall conform to the line, grade, and section shown on the drawings.
- 8.8. **FINISHING.** The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.
- 8.9. **SMOOTHNESS.** The surface of each the layer shall show no deviations in excess of 3/8 inch when tested with a 10-foot straightedge applied both parallel with and at right angles to the centerline of the base-course area. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting.
- 8.10. **THICKNESS CONTROL.** The Contractor shall control his operations by measurements to insure placement of materials to the thickness specified. Thickness measurements shall be made by test holes at least 3 inches in diameter through the course. One depth measurement shall be made for each 500 square yards or part thereof of base course. Measurements may be made by the Government for verification of compliance; however, the Contractor shall not depend on such measurements for his control of operations. The completed thickness of the base course shall be within 1/2 inch plus or minus of the thickness shown on the drawings. Where the measured thickness is deficient by more than 1/2 inch, the Contractor shall correct such areas by scarifying, adding mixture of proper gradation, reblading and recompacting. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness indicated.
9. **MAINTENANCE.** The crushed aggregate base course shall be maintained in a satisfactory condition until accepted. Areas of crushed aggregate base course damaged by freezing, rainfall or other weather conditions shall be corrected to meet specified requirements.

ZERO ACCIDENTS

SECTION 02480 SEEDING

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PART 1 - GENERAL

1. **APPLICABLE PUBLICATIONS.** The following publications of the issues listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
 - 1.1. **FEDERAL SPECIFICATION (Fed. Spec.).**
 - 1.2. **U.S. DEPARTMENT OF AGRICULTURE.**

Federal Seed Act of 9 August 1939 (53 Stat. 1275)
2. **GENERAL REQUIREMENTS.** The specified seed varieties and quantities shall be uniformly distributed over all ground areas disturbed by grading and/or trenching and not otherwise surfaced and in such manner that will produce an even stand of grass over the entire area seeded, as shown on attached Standard Drawing No. 16-10-01, Sheet 2. The Contractor shall notify the Contracting Officer at least 10 days prior to seeding operations.
3. **SOIL TEST.** The Contractor shall obtain Agricultural Soil Tests to determine fertilizer requirements. Test reports shall be submitted to the Contracting Officer in accordance with paragraph: SUBMITTALS.
4. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit the following items:
 - 4.1. **CATEGORY I.** None.
 - 4.2. **CATEGORY II.** Submit for information only.
 - 4.2.1. **Certificates of Compliance:**
 - 4.2.1.1. Seed.
 - 4.2.1.2. Fertilizer.
 - 4.2.1.3. Agricultural Soil Test Report.
 - 4.2.2. **Manufacturer's Literature:**

- 4.2.2.1. Hydro-Mulch.
- 4.2.2.2. Erosion Control Materials.

5. DELIVERY, STORAGE, AND HANDLING.

5.1. DELIVERY.

- 5.1.1. **Seeding Material** shall be inspected upon arrival at the jobsite, and unacceptable material shall be removed from the jobsite.
- 5.1.2. **During Delivery, Seed** shall be protected from any drying or contamination by detrimental material.
- 5.1.3. **Fertilizer** shall be delivered to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state and federal law.
- 5.1.4. **Chemical Treatment of Materials.** Pesticides and Herbicides shall be delivered to the site in the original unopened containers. Containers without labels and EPA registration numbers and the manufacturer's registered uses will be rejected by the Contracting Officer.

5.2. STORAGE.

- 5.2.1. **Seed and Fertilizer** shall be stored in cool, dry locations away from contaminants.
- 5.2.2. **Pesticides and Herbicides** shall not be stored with other landscape materials and shall be handled and stored following manufacturer's directions.
- 5.2.3. **Materials** shall be stored in areas designated or as approved by the Contracting Officer.

PART 2 - PRODUCTS

6. MATERIALS.

6.1. **SEED** shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weed-seed content, and inert material. Labels shall conform with USDA Federal Seed Act, Rules & Regulations and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

6.1.1. **Lawn Seed Mixture.** The mixture of each seed lot shall contain the following types of seed and their pounds of Pure Live Seed (PLS) per 1,000 square feet:

6.1.2. **Field Seed Mixture.** The mixture of each seed lot shall contain the following types of seed and their pounds of Pure Live Seed (PLS) per acre:

The following formula shall be used to determine the amount of commercial seed required to provide in each kind of seed the specified quantities of pure live seed, with Purity and Germination expressed as whole numbers:

$$\frac{\text{Pure Live Seed} \times 100 \times 100}{\text{Purity} \times \text{Germination}} = \text{Pounds Commercial Seed Required}$$

- 6.2. **FERTILIZER** shall be controlled-release, commercial grade, granular free flowing, uniform in composition, delivered in fully labeled sealed containers, and shall conform to applicable state and federal regulations. Fertilizer shall conform to Fed. Spec. O-F-241, and shall bear the manufacturer's guaranteed statement of analysis.
- 6.3. **TOPSOIL.** The existing topsoil located on site should be used.
- 6.4. **TOPSOIL FOR REPAIR.** Erosion repair topsoil shall be obtained by the Contractor from off Base areas approved by the Contracting Officer] if topsoil is not available from the grading operations. Topsoil for repair shall be a natural, friable soil representative of agriculturally productive soils in the vicinity. It shall be obtained from well-drained areas and shall be free of any admixture of subsoil, toxic substances, and any material or substance that may be harmful to plant growth.
- 6.5. **MULCH.**
 - 6.5.1. **Straw Mulch** shall be stalks from oats, wheat or rye that are free from noxious weeds, mold, or other objectionable material. The straw mulch shall contain at least 50 percent by weight of the material to be 10 inches or longer. Straw shall be in an air-dry condition and suitable for placing with blower equipment.
 - 6.5.2. **Wood Cellulose Fiber Mulch And Tackifier** shall be wood cellulose fiber and shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 3.5 to 5.0. Use with hydroseeding application of grass seed and fertilizer. When added to water, it forms a homogenous slurry specifically for use in hydraulic mulching and seeding equipment. Tackifier shall be a natural vegetable gum, blended with gelling and hardening agents. This material, when mixed with wood cellulose and water becomes a tackifier/ binder to act as an agent for erosion control and provides a stable bed for seed germination.
- 6.6. **WATER** shall be a quality suitable for irrigation.
- 6.7. **CHEMICAL TREATMENT MATERIAL** shall be EPA registered and approved herbicides and pesticides. These materials shall comply with all applicable state and federal laws.
- 6.8. **SOIL EROSION CONTROL MATERIAL, AND STAPLES.**
 - 6.8.1. **Soil Erosion Control Blanket** shall consist of a machine-laid mat of curled wood excelsior, fibers of which 80 percent are 6 inches or longer. The excelsior fiber shall be burred wood fiber from nonresinous timber. The fiber thickness shall be consistent and evenly distributed over the entire area of the blanket. The top side of each blanket shall be covered with a photodegradable extruded plastic mesh. Mesh size shall be a minimum of 1 inch by 2 inches. Blankets shall be made smolder resistant without chemical additives. Roll size specifications are: roll width 48 inches, length 180 feet average, area coverage 80 square yards average, roll weight approximately 78 pounds.
 - 6.8.2. **Staples** shall meet the Erosion Control Material manufacturer's instructions.

PART 3 - EXECUTION

7. DATES FOR SEEDING.

- 7.1. **LAWN SEEDING.** The Contractor shall prepare the seedbed and perform lawn seeding as specified in paragraph: MATERIALS between the dates of:

Spring: Spring Thaw to June 15

Fall: September 15 to consistent ground freeze

- 7.2. **FIELD SEEDING.** The Contractor shall prepare the seedbed and perform field seeding as specified in paragraph: MATERIALS between the dates of:

Spring: 1 May to 31 May (Preferred)

Dormat: 1 November to 31 May (Used when schedules do not allow spring planting. Dormat seeding only after soil temperatures are below 60 deg. F. No seeding when soil is frozen or muddy.)

8. **PREPARATION OF SEEDBED.**

- 8.1. **GENERAL.** The Contractor shall replace topsoil and reestablish existing grades in accordance with the Profile. Any eroded finish grades shall be repaired in accordance with the MATERIALS paragraph: TOPSOIL FOR REPAIR.

- 8.2. **TILLAGE.** The soil shall be tilled to a depth of at least 4 inches by plowing, disking, harrowing, or rototilling. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work should be stopped. The soil surface shall be leveled to meet finish grade requirements before seeding. Seedbed preparation shall be performed on the contour to reduce soil loss. Slopes 2 horizontal to 1 vertical and greater, minimum tillage depth shall be 2 inches.

- 8.3. **APPLICATION OF FERTILIZER.** Fertilizer shall be incorporated into the soil to a depth of 2 inches during seedbed preparation. When hydro-seeding is specified, the fertilizer may be applied with the use of hydro-seed and mulch.

8.4. **FERTILIZER RATE.**

- 8.4.1. Apply fertilizer at a rate to supply no less than 200 pounds of fertilizer mix per acre of seeded area.

- 8.4.2. Fertilizer shall be applied at the rate determined by the Contractor's Agricultural Soil Test. Test reports shall be submitted to the Contracting Officer in accordance with paragraph: SUBMITTALS. Bids shall be based on the following application rate of actual or available fertilizer; if the following rate is more or less than the rate required by paragraph: SOIL TEST an adjustment in the Contract Price will be made as provided in the CONTRACT CLAUSES, clause "changes":

LAWN SEEDING:

Nitrogen (N) 1 lbs./1,000 SF

Phosphorus (P_2O_5) 2 lbs./1,000 SF

Potassium (K_2O) 2 lbs./1,000 SF

FIELD SEEDING:

Nitrogen (N) 10 lbs./acre

Phosphorus (P_2O_5) 20 lbs./acre

Potassium (K_2O) 20 lbs./acre

9. **PLANTING SEED.**

- 9.1. **GENERAL.** Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rains, traffic, or other cause, shall be reworked to restore the ground condition previously specified. Seed shall be planted at the rate specified herein.
- 9.2. **METHODS.** Seed planting shall be accomplished by:
- 9.2.1. **Broadcast Seeding.** The Contractor shall broadcast seed by hand or with approved gravity or cyclone types of spreading equipment. Broadcast seedings shall be covered to an average depth of 1/4 inch. Completed seeding shall be mixed into soil with a harrow or rake or compacted with a cultipacker-type roller providing 60 to 90 pounds weight per linear foot of roller, or by equivalent approved hand rolling or compacting methods. Broadcast seeding will not be permitted when wind velocity is such as to prevent uniform seed distribution.
- 9.2.2. **Drill Seeding.** The Contractor shall plant seed with a grass seed drill equipped with seeding mechanisms, agitator, double disk furrow openers and packer wheels or drag chains. The seed drill shall plant, cover and compact the seedbed in the same operation. The distance between drill rows shall not be more than 6-1/2 inches apart with planting depth of 1/4 - 1/2 inch. Drill seeding is recommended over broadcast for large areas of field seeding.
- 9.2.3. **Hydro Seeding.** The Contractor shall accomplish seeding, fertilizing, and mulching by hydroseed application. Hydro seeding shall not be used for dormant fall field-type seeding. Seed and fertilizer in the amount per acre designated, wood cellulose fiber mulch and tackifier/binding agents at the rates recommended by the manufacturer for the specific fiber mulch used, shall be combined with water to provide a slurry, and hydraulic application shall be performed in such manner that the liquid carrier will uniformly distribute the material over the entire area to be seeded at rates not less than indicated herein. No following compaction shall be done. The seeded area shall be watered after seeding and the soil moistened to a depth of 2 to 4 inches.
- 9.3. **VEGETATIVE MULCHING.** The contractor shall perform vegetative mulching on the same day as planting seed. Vegetative mulching is not required on hydro-seeding.
- 9.3.1. **Applying Mulch.** Straw mulch shall be spread uniformly in a continuous blanket over the seeded areas, using 2 tons of material per acre. The mulch shall be spread in such manner as to prevent bunching.
- 9.3.2. **Securing Mulch.** Immediately following the spreading of the mulch, the material shall be anchored securely into the soil a minimum of 3 inches by means of a mulch anchoring machine equipped with large coulter-type discs spaced on approximate 8-inch centers. Edges of the discs shall be dull to prevent cutting of the mulching and equipment operation shall be such as to embed the mulch to the required depth. In areas where equipment cannot be used, mulch shall be secured by shallow covering of earth or by embedding with approved hand methods, including straight-bladed spade with dulled edge.
10. **PROTECTION AND CLEANUP.** After seeding and mulching operations have been completed, barricades and approved warning signs shall be erected by the Contractor as required to provide protection against traffic and trespass. Excess material from seeding and mulching operations, and all debris, shall be cleaned up and disposed of off the site.
11. **ESTABLISHMENT AND MAINTENANCE PERIOD.**
- 11.1. **LAWN SEEDING.** The Contractor is responsible for the establishment and maintenance of lawn seeding for a minimum period of 45 days or until all of the work on the project has been completed and accepted by the Contracting Officer, for whichever period is longer.
- 11.1.1. **Stand of Grass** shall be a minimum of 500 grass plants per square foot over the seeded area after the second mowing.

- 11.1.2. **Mowing** shall be to a height of 2 1/2 inches whenever the height of lawn grass becomes 4 inches. The Contractor shall catch, collect, and remove clippings. Mowing is required until project completion and acceptance.
- 11.1.3. **Watering** lawn grass shall be frequent, usually once per day. The Contractor shall keep the ground moist to a depth of 2 to 4 inches. Grass shall be watered at such rates to prevent wilting, puddling, runoff, and damage to grades. Irrigation equipment shall be Contractor furnished.
- 11.1.4. **Reseeding and Repair.** During the establishment and maintenance period any eroded or damaged seeding shall be repaired and reseeded by the Contractor.
- 11.2. **FIELD SEEDING.** The Contractor is responsible for the establishment and maintenance of field seeding for a minimum period of 45 days or until all of the work on the project has been completed and accepted by the Contracting Officer, for whichever period is longer.
 - 11.2.1. Watering of field seeding is not required.
 - 11.2.2. Mowing shall be provided by the Contractor for weed control and as directed by the Contracting Officer. The Contractor shall maintain an approximate 6-inch minimum height of grass and weeds during the maintenance period.
 - 11.2.3. **Reseeding and Repair.** During the maintenance period, any eroded or damaged seeding shall be repaired and reseeded by the Contractor.
- 12. **CHEMICAL TREATMENT.** Herbicides and pesticides shall be applied as directed by the Contracting Officer for the control of weeds or pests that may damage seeded areas. Application shall be by a certified applicator and performed in accordance with manufactures recommendations stated on the container label. When weeds are sprayed they should be 4 to 6 inches high if they are thick enough to shade the ground completely. The seeded grass should be in at least a two- to four-leaf stage before spraying.
- 13. **FINAL ACCEPTANCE.** Final inspection and acceptance will be at the end of the Establishment and Maintenance Period. Acceptance will be based upon material, performance and completion of all the items of work specified for SEEDING. Unacceptable work shall be reseeded by the Contractor.

ZERO ACCIDENTS

SECTION 02551 BITUMINOUS INTERMEDIATE AND SURFACE COURSES (CENTRAL PLANT HOT MIX)

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

1.1. **MILITARY STANDARD (MIL STD).**

MIL-STD-620A Test Methods for Bituminous Paving Materials & Notice 1

1.2. **U.S. ARMY CORPS OF ENGINEERS HANDBOOK FOR CONCRETE AND CEMENT.**

CRD-C 130-79 Scratch Hardness of Coarse Aggregate Particles

CRD-C 119-53 Flat and Elongated Particles in Coarse Aggregate (Rev Jun 63)

1.3. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS.**

- | | |
|-----------|--|
| C 29-87 | Unit Weight and Voids in Aggregate |
| C 88-83 | Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| C 117-87 | Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| C 127-84 | Specific Gravity and Absorption of Coarse Aggregate |
| C 128-84 | Specific Gravity and Absorption of Fine Aggregate |
| C 131-87 | 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 566-84 | Total Moisture Content of Aggregate by Drying |
| D 5-83 | Penetration of Bituminous Materials |

D 75-87	Sampling Aggregates
D 140-88	Sampling Bituminous Materials
D 242-85	Mineral Filler for Bituminous Paving Mixtures
D 946-82	Penetration-Graded Asphalt Cement for Use in Pavement Construction
D 1250-80	Petroleum Measurement Tables
D 1856-79 (R 1984)	Recovery of Asphalt from Solution by Abson Method
D 2172-81	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
D 3381-83	Viscosity-Graded Asphalt Cement for Use in Pavement Construction

2. **GENERAL DESCRIPTION.** Bituminous surface course shall be placed and compacted on a prepared base course. All quality control sampling and testing results and reports shall be included in the Contractor's Daily Quality Control Reports. Place bituminous surface to match thickness and elevation of existing pavement.
3. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit the following items.
 - 3.1. **CATEGORY I.** None.
 - 3.2. **CATEGORY II.** (for information only)
 - 3.2.1. Aggregate Test Results. (Para. 9.1)
 - 3.2.2. Certified Refinery Analysis. (Para. 9.2)
 - 3.2.3. Mix Design. (Para. 13.1)
4. **PLANT, EQUIPMENT, MACHINES, AND/OR EXISTING PAVEMENT TOOLS.**
 - 4.1. **GENERAL.** The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.
 - 4.2. **MIXING PLANTS.** The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). The plant shall have a minimum capacity of 100 tons per hour. Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.
 - 4.3. **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 confining

edges of strips to true lines without use of stationary side forms and capable of placing the course to the required thickness. Spreaders shall be designed to operate forward at variable speeds and in reverse at traveling speeds of not less than 100 feet per minute. If an automatic grade control device is used on the spreader for two-lane paving operations, it shall consist of a sensing device for control of one end of the screed and a slope-control mechanism for control of the other 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.

4.4. VIBRATORY ROLLERS shall be self-propelled, double-drum, steel wheel vibratory rollers having an average operating weight per drum of at least 150 pounds per lineal inch of drum. The rollers shall transmit a dynamic impact to the surface through smooth steel drums by means of revolving weights, eccentric shafts, or other equivalent methods. The roller shall have a vibrating frequency of at least 1500 cycles per minute. The amplitude shall be between 0.015 inch and 0.040 inch at the operating frequency used. Controls shall permit ready variation of the amplitude at a minimum of two settings over at least 50 percent of the above range. The roller drum shall be between 48 and 66 inches in diameter and 66 to 96 inches in width. The roller shall be operated at speeds not exceeding 1.5 miles per hour. Within the range of the operational capability of the equipment, the Contracting Officer may direct or allow variations within the specified range to the frequency, amplitude, and speed of operation which result in the required density and satisfactory surface texture at the fastest production rate. Roller shall be equipped with some means of keeping the drums damp during operation. Each drum shall be equipped with an operating scraper and pad. Any rollers which pick up material from the surface of the pavement shall be adjusted, modified, or replaced.

4.4.1. RUBBER-TIRED ROLLERS shall be furnished for rolling the pavement surface after use of the vibratory or steel wheel roller. The rubber-tired roller shall have smooth tires, shall have non-oscillating wheels and shall be capable of being operated at a tire pressure between 50 and 90 psi and with a total load between 3,000 and 4,500 pounds per wheel. The roller shall have two axles with at least three wheels per axle, offset so that front and back tires do not track in the same path. At least one rubber-tired roller shall be used at all times during construction.

4.5. STEEL-WHEEL ROLLERS shall be self-propelled, three-wheel, (two-axle) or tandem (two-axle) types, weighing not less than 20,000 pounds each. The three-wheel rollers shall have a minimum weight of 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 projections 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.

4.6. SMALL TOOLS shall consist of rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heater for heating small tools, and other small tools in numbers as required.

4.7. STRAIGHTEDGE. 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 working condition at the site, one such device for each bituminous paver.

5. WEATHER LIMITATIONS. Bituminous courses shall be constructed only when the base course or intermediate course or existing pavement 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 40 degrees F.

6. **PAVEMENT PROTECTION.** After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.
7. **SURFACE REQUIREMENTS.**
 - 7.1. **BITUMINOUS SURFACE COURSE.** The surface course, upon completion of final rolling, shall be smooth and true to grade and cross section. When a 10-foot straightedge is laid on the surface parallel with the centerline, the surface shall not vary more than 1/8 inch from the straightedge. When the 10-foot straightedge is laid on the surface transverse to the centerline between the crown and edge of pavement, the surface shall not vary more than 1/4 inch from the straightedge. Low or defective areas shall be immediately corrected by cutting out the faulty areas and replacing 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.
 - 7.2. **PLAN GRADE.** The grade of the completed surface shall not vary more than 0.05 foot from the plan grade.
8. **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 SECTION: SPECIAL CLAUSES. 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.
9. **SAMPLING AND TESTING.**
 - 9.1. **GENERAL.** All quality control sampling, testing and establishing of the bituminous mix design shall be the responsibility of the Contractor in accordance with paragraph: CONTRACTOR QUALITY CONTROL in SECTION: SPECIAL CLAUSES and as specified herein. All sampling, testing and establishing of the bituminous mix design shall be performed by an approved commercial testing laboratory. The Government may perform verification tests as considered necessary. Sampling shall be performed in accordance with ASTM Standard D 75 for aggregates and ASTM Standard C 183 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.
 - 9.2. **SAMPLING, TESTING, AND APPROVAL OF BITUMINOUS MATERIALS.** A sample of the asphalt and a certified refinery analysis from the proposed source shall be furnished along with the proposed job-mix formula. In addition, a certified refinery analysis shall be furnished for each shipment of bituminous 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.
 - 9.3. **SAMPLING, TESTING, AND APPROVAL OF BITUMINOUS MIXTURES DURING CONSTRUCTION.**
 - 9.3.1. **General.** Samples of plant mixtures shall be taken before the material is placed in the pavement and shall be tested to determine conformance to the specified test properties of bituminous mixtures and to determine bitumen content and aggregate gradation. All quality control sampling and testing shall be the responsibility of the Contractor in

accordance with paragraph: CONTRACTOR QUALITY CONTROL in SECTION: SPECIAL CLAUSES and as specified herein. All testing shall be performed by an approved commercial testing laboratory. All tests shall be performed expeditiously and results immediately furnished the Contractor and Government representatives at the construction site or mixing plant. In no case, after construction commences, shall operations for any half day (morning or afternoon) commence until results of tests performed on samples taken during the previous half day are available, and adjustments in the mix made if necessary. 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.

9.3.2. Testing Frequency.

- 9.3.2.1. **Marshall Tests.** One set (three specimens) of tests shall be made for each 300 tons of hot mix produced, except that a minimum of two sets per day shall be made.
- 9.3.2.2. **Extraction Tests** shall be made to determine bitumen content and aggregate gradation at the same frequency specified above for Marshall tests.
- 9.3.2.3. **Immersion Compression 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.
- 9.3.2.4. **Moisture Tests.** If dryer-drum mixing process is used, the Contractor shall obtain samples of the bituminous mixture as it is discharged from the dryer-drum mixer and shall test for moisture. Frequency of sampling and testing shall consist of at least two samples during the first 4 hours of each day's production and at least one during the remainder of the day.

- 10. **SAMPLING PAVEMENTS.** Samples of finished pavement, including samples that span the longitudinal joints, shall be obtained by the Contractor. The type, size, and location of the samples shall be as directed, except that cores shall be at least 4 inches in diameter and sawed samples at least 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 paragraph: CONTRACTOR QUALITY CONTROL in SECTION: SPECIAL CLAUSES and as specified herein. All testing shall be performed by an approved commercial testing laboratory. 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 Government may perform verification tests as considered necessary. The Contractor shall furnish a power saw or core drill and labor for cutting samples and shall immediately replace the pavement to the satisfaction of the Contracting Officer at no additional cost to the Government. One sample shall be taken and tested for each 200 tons or less of bituminous mixture placed each day, except that additional samples shall be taken and tested at the start of the paving operations when directed. However, the maximum number of samples required each day shall be six. One-half of the samples shall be cut from longitudinal joints.
- 11. **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.

12. **BITUMINOUS HOT MIX.** Bituminous hot mix shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the qualities and in the proportions specified and shall conform to the requirements contained in Paragraph: PROPORTIONING OF MIXTURE.

12.1. **AGGREGATES** shall consist of crushed stone, crushed gravel, screenings, sand, and mineral filler. The portion of these materials retained on the No. 4 sieve shall be known as coarse aggregate; the portion passing the No. 4 sieve and retained on the No. 200 sieve, as fine aggregate; and the portion passing the No. 200 sieve, 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 subsequent paragraphs entitled AGGREGATE GRADATION and COMPOSITION OF MIXTURE.

12.1.1. **Coarse Aggregates** shall consist of clean, sound, durable fragments of crushed stone or crushed gravel meeting the following requirements.

12.1.1.1. **Percentage of Wear** shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.

12.1.1.2. **Percentage of Loss** shall not exceed 18 after five cycles performed in accordance with ASTM C 88, using magnesium sulfate.

12.1.1.3. **Crushed Gravel** retained on the No. 4 sieve and each coarser sieve listed in paragraph: AGGREGATE GRADATION shall contain at least 80 percent by weight of crushed pieces having two or more fractured faces. When two fractures are contiguous, the angles between planes of fractures shall be at least 30 degrees to count as two fractured faces.

12.1.1.4. **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 CRD-C 119.

12.1.2. **Fine Aggregates** shall consist of clean, durable natural sands; manufactured sands prepared by crushing stone, slag or gravel; or any combination of natural and manufactured sands. Natural sands shall consist of grains of clean, hard, durable rock. Quantity of natural sand to be added to the surface [and intermediate] course mixtures shall not exceed 25 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter. Fine aggregate produced by crushing shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve.

12.1.2.1. **Mineral Filler.** Mineral filler shall conform to ASTM Standard D 242 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.

12.1.3. **Bulk-Impregnated Specific Gravity** of the aggregates shall be determined in accordance with Method 105 of Military Standard MIL-STD-620.

12.1.4. **Aggregate Gradation.** Mineral aggregate shall be of such size that the percentage composition by weight, as determined by ASTM Standards C 136 and C 117, will conform to one of the gradations specified at the end of this paragraph. The gradations shown represent the extreme limits which shall determine suitability of aggregate for use from all sources of supply. The aggregate as finally selected for use in the work shall have a gradation within the limits specified, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but shall be uniformly graded from coarse to fine. The table is based on aggregates of uniform specific gravity, and

the percentages passing the various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Regardless of the gradation option 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 which fails to produce a bituminous mixture meeting all requirements specified shall be rejected and replaced with a satisfactory aggregate at no additional cost to the Government, and with no extension of time due to any delay caused by such replacement.

TABLE 1

Percent Passing, by Weight

Sieve Size	1-inch Maximum	3/4-inch Maximum Surface Course	1/2-inch Maximum
1 inch	100		
3/4 inch	83-97	100	
1/2 inch	72-90	80-98	100
3/8 inch	66-84	73-91	77-95
No. 4	51-69	57-75	57-75
No. 8	38-56	44-62	44-62
No. 16	28-46	32-50	32-50
No. 30	18-36	22-40	22-40
No. 50	11-27	13-29	13-29
No. 100	8-18	7-19	7-19
No. 200	2-7	2-7	2-7

13. PROPORTIONING OF MIXTURE.

13.1. **JOB-MIX FORMULA.** The proposed mix design, aggregate test results, and certified refinery analysis shall be submitted to the Contracting Officer 45 days before production of bituminous mixture. The Contracting Officer will submit the data directly to the Missouri River Division (MRD) Laboratory, 420 South 18th Street, Omaha, Nebraska, for approval. No bituminous mixture shall be produced until the job-mix formula determined from the bituminous mix design has been approved by the MRD Laboratory. The bituminous mix design shall be established in accordance with MIL-STD-620A, Method 100. 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.

Aggregate passing No. 4 sieve or larger	5 percent plus or minus
Aggregate passing Nos. 8, 16, 30 and 50 sieves	4 percent plus or minus
Aggregate passing Nos. 100 and 200 sieves	2 percent plus or minus
Asphalt as determined by extraction tests made in accordance with ASTM D 2172	0.25 percent plus or minus
Temperature of mixing	25 degrees F. plus or minus

The bitumen content and aggregate gradation may be adjusted within the limits of the tables specified herein to improve the paving mixtures, as directed, without adjustments in the contract price. 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.

13.2. **TEST PROPERTIES OF BITUMINOUS MIXTURES.** The finished mixture shall meet the requirements hereinafter described when tested in accordance with MIL-STD-620A.

13.2.1. **Stability, Flow and Voids.**

- 13.2.1.1. For Nonabsorptive Aggregate.** When the water absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined by ASTM Standards C 127 and C 128, the aggregate will be designated as nonabsorptive. The apparent specific gravity shall be used in computing the voids total mix and voids filled with bitumen, and the mixture shall meet the following requirements.

<u>Test Property</u>	<u>Base Course</u>
Stability, minimum, pounds	500
Flow, maximum, 1/100-inch units	20
Voids, total mix, percent	3 - 5
Voids, filled with bitumen, percent	75 - 85

13.2.2. Reduction in Stability by Immersion. If the index of retained stability of the specimens of composite mixture is less than 76, when tested in accordance with the Immersion Compression Test described in MIL-STD-620A, the aggregates shall be rejected or the bitumen shall be treated with an approved anti-stripping agent. The amount of anti-stripping agent to be added to the bitumen shall be sufficient, as approved by the Contracting Officer, to produce an index of retained stability greater than 75 when specimens of the mixture conforming to the proposed job mix formula using the treated bitumen are tested in accordance with the immersion compression test described in MIL-STD-620A. No additional payment will be made to the Contractor for any addition of anti-stripping agent that may be required.

13.2.3. Moisture Content. If dryer-drum mixing process is used, the moisture content of the bituminous mixture shall not exceed 3.0 percent when discharged from the dryer-drum mixer. Samples of bituminous material for moisture determination shall consist of not less than 10 pounds of material obtained at one time immediately after discharge from the mixer. Moisture content shall be determined by the same process specified for hot bin aggregate samples in paragraph: WATER CONTENT OF AGGREGATES, using the same type containers, except only one sample is used and there is no weighted average to be computed.

13.3. CONTRACTOR'S OPTION. At the option of the Contractor, in lieu of developing a new job-mix formula for surface course construction, the Contractor may use job-mix formulas for surface course construction currently in use on another nearby Corps of Engineers project or currently in use by the Colorado State Highway Department for surface courses (State Highway mix) for primary road construction provided in each instance that the same materials proposed for use on this project are being used and provided the mix meets all criteria specified in subparagraph: Properties of Bituminous Mixtures. If the Contractor proposes to use such other in-use job-mix formula, the proposed job-mix formula plus certified results of tests performed by a commercial laboratory showing that the job-mix formula meets all requirements specified herein shall be submitted to the Contracting Officer at least 60 days prior to commencing construction. 60 days is appropriate after review by COE and PMRMA. The Contracting Officer will submit the data directly to the MRD Laboratory for approval. Use of this option will permit no changes to aggregate requirements or to other requirements specified in this section and shall not be the basis for additional cost to the Government or extension of time.

14. CONDITIONING OF BASE COURSE. Previously constructed base course shall be conditioned as specified herein. Prior to laying the bituminous course, the surface shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed.

14.1. BASE COURSE. The surface of base course will be inspected by the Contracting Officer for adequate compaction and surface tolerances as specified in SECTION: CRUSH AGGREGATE BASE COURSE. Unsatisfactory areas shall be corrected as approved or directed.

14.2. EXISTING PAVEMENT.

15. **PREPARATION OF BITUMINOUS MIXTURES.** Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the job mix formula. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F. when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.
- 15.1. **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 2-1/2 percent or less, and to less than 0.50 percent for aggregate blends with water absorption greater than 2-1/2 percent, absorption to be determined by ASTM Standards C 127 and C 128. The water absorption for the aggregate blend shall be the weighted average of the absorption values for the coarse aggregate and the fine aggregate. The water content test shall be conducted in accordance with ASTM C 566. Water content for the blend will be a weighted average based on the composition of the blend.
- 15.2. **STORAGE OF BITUMINOUS PAVING MIXTURE** shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.
16. **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 1 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.
17. **PLACING.**
- 17.1. **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.
- 17.2. **SPRAYING OF CONTACT SURFACES OF STRUCTURES.** Contact surfaces previously constructed shall be sprayed with a thin coat of bituminous material conforming to the requirements of SECTION: BITUMINOUS PRIME COAT. The edges of any existing bituminous surface in contact with the new surface shall be coated with a layer of bituminous material conforming to the requirements of SECTION: BITUMINOUS TACK COAT.
- 17.3. **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 at least 1 foot. Transverse joints in the surface course shall be offset by at least 2 feet from transverse joints in the intermediate course.
- 17.4. **GENERAL REQUIREMENTS FOR USE OF MECHANICAL SPREADER.** The range of temperatures of the mixtures, when dumped into the mechanical spreader shall be as determined by the Contractor. Asphalt mixtures having temperatures less than 250 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 10 feet, except when edge lanes require strips less than 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 compatible 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.

- 17.5. **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 of the mechanical spreader shall overlap the previously placed strip 3 to 4 inches and shall be sufficiently high so that compaction will produce a smooth, dense joint. Mixture placed on the edge of the previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip being placed by use of a lute. 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.
- 17.6. **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.
- 17.7. **HAND SPREADING IN LIEU OF MACHINE SPREADING.** In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. 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.

18. **COMPACTION OF MIXTURE.**

- 18.1. **GENERAL.** Compaction of the mixture shall be accomplished by the vibratory rollers and/or steel-wheel rollers and rubber-tired rollers specified above. The initial rolling with the vibratory or steel-wheel roller shall begin as soon after placing as the mixture will bear a roller without undue displacement. Intermediate rolling with the rubber-tired roller shall follow the initial rolling as closely as possible and shall be done while the paving mix is still at a temperature that will result in maximum density. Finish rolling with the steel-wheel roller shall be accomplished while the material is still workable enough to remove roller marks. 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 specimens of same mixture.

- 18.2. 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 Method 101 of MIL-STD-620A.
- 18.3. OPERATION OF ROLLERS AND TAMPERS.** 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 where necessary. Alternate passes of the roller shall be varied slightly in length. During rolling, the wheels of the vibratory and steel-wheel rollers shall be moistened to prevent adhesion of the mixture to the wheels, but excess water will not be permitted. Tires of rubber-tired rollers 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 furnished by the Contractor for each spreading machine operating on the job shall be one vibratory roller, one rubber-tired roller, and one steel-wheel roller or two steel-wheel rollers and one rubber-tired roller. Places inaccessible to rollers shall be thoroughly compacted with hot hand-tampers.
- 18.4. TESTING OF MIXTURE.** At the start of the plant operation, a quantity of mixture shall be prepared that is sufficient to construct a test section at least 50 feet long, two spreader widths wide and of thickness to be used in the project. Mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with the requirements specified above. This test section shall conform to all specified requirements. If test results are satisfactory, the test section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately, and the entire test section shall be removed, and an additional test section shall be constructed until an acceptable test section is constructed, all at no additional cost to the Government.
- 18.5. 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. 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.

19. JOINTS.

- 19.1. GENERAL.** Joints between successive day's work, or joints that have become cold because of delay, 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. Contact surfaces of previously constructed pavements that have become coated with dust, sand, or other objectionable material shall be cleaned by brushing or cut back with an approved power saw or other approved device, as directed. The surface against which new material is to be placed shall be sprayed with a thin, uniform coat of bituminous material. 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.
- 19.2. 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.

- 19.3. **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.
- 19.4. **EDGES OF PAVEMENT** adjacent to the shoulders shall be trimmed neatly to line. An earth berm of selected material not less than 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.

ZERO ACCIDENTS
SECTION 02558
BITUMINOUS TACK COAT

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

1.1. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.**

D 140-70 (R 1981)	Sampling Bituminous Materials
D 977-86	Emulsified Asphalt D 2028-76 Cutback Asphalt (Rapid-Curing Type) (R 1986)
D 2397-85	Cationic Emulsified Asphalt

2. **BITUMINOUS MATERIAL** shall be cutback asphalt conforming to the requirements of ASTM D 2028, designation RC-70 or RC-250, emulsified asphalt conforming to the requirements of ASTM D 977, designation SS-1 or SS-1h, or cationic emulsified asphalt conforming to the requirements of ASTM D 2397, designation CSS-1 or CSS-1h.

3. **SAMPLING, TESTING, AND APPROVAL OF BITUMINOUS MATERIAL.**

3.1. **SAMPLING.** Samples of bituminous material shall be obtained in accordance with ASTM D 140.

3.2. **TESTING.**

3.2.1. **Certified Test Results.** At least 30 days before bituminous materials are delivered to the project, the proposed source of materials shall be designated and a certified refinery analysis of the proposed material shall be submitted.

3.2.2. **Trial Applications.** As a preliminary to providing the complete tack coat, up to three lengths of at least 100 feet each for the full width of the distributor bar shall be tacked as directed. Bituminous materials in the amount of 0.10 gallon per square yard shall be used for one trial. The other trial applications shall be made using various amounts of material as directed.

3.2.3. **Calibration Test.** The Contractor shall furnish such equipment and materials and perform the work to calibrate the tank and measuring devices of the distributor. This shall be done on the job at the beginning of the work.

3.3. **DELIVERY AND STORAGE.** Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling.

- 3.3. **DELIVERY AND STORAGE.** Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling.
4. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit the following items required by this section.
- 4.1. **CATEGORY I.** None.
- 4.2. **CATEGORY II.** (For Information Only).
- Source of Bituminous Materials and Certified Refinery Analysis (Para. 3.2.1.)
5. **QUANTITIES TO BE APPLIED.** Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon of cutback asphalt or undiluted asphalt emulsion per square yard of surface. Asphalt emulsion shall be diluted and thoroughly mixed with equal parts of water and this mixture applied at a rate within limits of two times the rates given for the undiluted emulsion. The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.
6. **EQUIPMENT, TOOLS, AND MACHINES** used in the performance of the work required by this section of the specifications shall be subject to approval and shall be maintained in satisfactory working condition at all times.
- 6.1. **BITUMINOUS DISTRIBUTOR** shall have pneumatic tires of such width and number that the load produced on the base surface shall not exceed 650 pounds per inch of tire width. The distributor shall be designed and equipped to distribute the bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard with a pressure range of 25 to 75 pounds per square inch and with an allowable variation from any specified rate not to exceed 5 percent. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gages, volume measuring devices, adequate heaters for heating materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hose attachment suitable for applying bituminous material manually to cover areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.
- 6.2. **HEATING EQUIPMENT FOR STORAGE TANKS.** The equipment for heating bituminous material shall consist of steam coils and equipment for producing steam, designed so that steam will not be introduced into the material. An armored thermometer with a range from 40 to 400 degrees F. shall be fixed to the tank so that the temperature of the bituminous material may be read at all times.
- 6.3. **POWER BROOMS AND POWER BLOWERS** shall be suitable for cleaning the surfaces to which the tack coat is to be applied.
7. **WEATHER LIMITATIONS.** The tack coat shall be applied only when the intermediate course, base course, or existing pavement is dry. The tack coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F. or above and when the temperature has not been below 35 degrees F. for 12 hours immediately prior to application, unless otherwise directed.
8. **PREPARATION OF SURFACE.** Immediately before applying the tack coat, if the surface is sufficiently bonded, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated with a power broom or blower, supplemented with hand brooms.

After the cleaning operation, and prior to the application of the tack coat, an inspection of the area to be treated will be made by the Contracting Officer to determine the fitness of the area to receive the bituminous coating. That portion of the surface prepared for immediate treatment shall be dry and in a satisfactory condition.

9. **APPLICATION OF BITUMINOUS MATERIAL.** Immediately following the preparation of the surface, the bituminous material shall be applied by means of a bituminous distributor.

9.1. **METHOD OF APPLICATION.** The bituminous material shall be applied at a pressure within the range of 25 to 75 pounds per square inch in the amounts directed. Bids shall be based on the application rate per square yard of 0.10 gallons; if the approved rate of application is more or less, an adjustment in the contract price will be made as provided in the CONTRACT CLAUSES clause: "Changes." The bituminous material shall be applied with uniform distribution at all points of the surface to be treated. Unless the distributor is equipped and operated to obtain satisfactory results 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 so that flow through the sprays may be started and stopped on the paper and so that all sprays will operate at full force on the surface to be treated. Immediately after the application, the building paper shall be removed and destroyed. All lightly coated areas and spots missed by the distributor shall be properly treated with the bituminous material. Following the application of bituminous material, the surface shall be allowed to cure until it is in a proper condition of tackiness to receive the surface course. The tack coat shall be applied only so far in advance of surface-course placement as is necessary to obtain the proper condition of tackiness as determined by the Contracting Officer. The Contractor shall furnish and spread a sufficient quantity of clean, dry sand on all areas that show an excess of bituminous material, to effectively blot up and cure the excess, when directed by the Contracting Officer. The blotter sand shall be removed prior to paving. The treated surface shall be maintained by the Contractor until the succeeding layer of pavement has been placed. During this interval the Contractor shall protect the treated surface against damage and shall repair all damaged spots at no additional cost to the Government. The surfaces of structures and vegetation adjacent to the area shall be protected by the Contractor in such a manner as to prevent their being spattered or marred by bituminous material.

9.2. **APPLICATION TEMPERATURE FOR LIQUID (CUT BACK) OR EMULSIFIED ASPHALT** shall be as directed and shall provide an application viscosity between 20 and 120 centistokes, kinematic, or 10 and 60 seconds, Saybolt-Furol. Application temperatures shall be within the following ranges, except that appropriate changes should be made when the range of viscosity is raised or lowered.

RC-70 ----- 120-190 degrees F.
RC-250 ----- 145-220 degrees F.
SS-1, SS-1h, CSS-1, CSS-1h -- 70-160 degrees F.

The temperature-viscosity relationship for liquid asphalt shall be furnished to the Contracting Officer.

ZERO ACCIDENTS

SECTION 02559
BITUMINOUS PRIME COAT

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| 5. QUANTITIES TO BE APPLIED | |

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

1.1. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.**

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| D 140-70
(R 1981) | Sampling Bituminous Materials |
| D 977-86 | Emulsified Asphalt D 2027-76 Cutback Asphalt
(Medium-Curing Type) (R 1986) |
| D 2397-85 | Cationic Emulsified Asphalt |

2. **BITUMINOUS MATERIALS** shall be liquid asphalt conforming to ASTM D 2027, designation MC-30 or MC-70, at the Contractor's option, except that only MC-30 shall be used on dense graded base courses if MC-70 does not adequately penetrate the base course material, or cationic emulsified asphalt conforming to ASTM D 2397, designation CSS-1 or CSS-1h, or emulsified asphalt conforming to ASTM D 977, designation SS-1 or SS-1h.

3. **SAMPLING, TESTING AND APPROVAL OF BITUMINOUS MATERIAL.**

- 3.1. **SAMPLING.** Samples of bituminous materials shall be obtained in accordance with ASTM D 140.

3.2. **TESTING.**

- 3.2.1. **Certified Test Results.** At least 30 days prior to delivery of bituminous materials to the project, the proposed source of material shall be designated and a certified refinery analysis of the proposed material shall be submitted.

- 3.2.2. **Trial Applications.** As a preliminary to providing the complete prime coat, up to three lengths of at least 100 feet each for the full width of the distributor bar shall be primed as directed. Bituminous materials in the amount of 0.25 gallon per square yard shall be used for one trial. The other trial applications shall be made using various amounts of material as directed.

- 3.2.3. **Calibration Test.** The Contractor shall furnish such equipment and materials and perform the work to calibrate the tank and measuring devices of the distributor. This shall be done on the job at the beginning of the work.

- 3.3. **DELIVERY AND STORAGE.** Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling.

4. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit items as specified herein on the following:
 - 4.1. **CATEGORY I.** None.
 - 4.2. **CATEGORY II.** (For Information Only)
 - Source of Bituminous Materials and Certified Refinery Analysis (Para. 3.2.1)
5. **QUANTITIES TO BE APPLIED.** Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon or more than 0.40 gallon per square yard of subgrade or base course. The exact quantities, which may be varied to suit field conditions, will be determined by the Contracting Officer. Prime coat shall be applied in two applications 24 hours apart when necessary to avoid flowing off of the surface because of grade or slope.
6. **EQUIPMENT, TOOLS AND MACHINES** used in the performance of the work required by this section shall be subject to approval and shall be maintained in satisfactory working condition.
 - 6.1. **BITUMINOUS DISTRIBUTOR** shall have pneumatic tires of such width and number that the load produced on the base surface shall not exceed 650 pounds per inch of tire width. The distributor shall be designed and equipped to distribute the bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 pounds per square inch and with an allowable variation not to exceed 5 percent from any specified rate. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gages, volume-measuring devices, adequate heaters for heating the materials to the proper application temperature, a thermometer to show the temperature of tank contents, and a hose attachment suitable for applying bituminous material to spots unavoidably missed by the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.
 - 6.2. **HEATING EQUIPMENT FOR STORAGE TANKS.** The equipment for heating bituminous material shall consist of steam coils and equipment for producing steam, so designed that steam cannot get into the material. An armored thermometer with a range from 40 degrees F. to 400 degrees F. shall be fixed to the tank so that the temperature of the bituminous material may be read at all times.
 - 6.3. **BROOMS AND BLOWERS** shall be of the power type and shall be suitable for cleaning prepared subgrade or base course.
7. **WEATHER LIMITATIONS.** The prime coat shall be applied only when the subgrade or base course is dry or contains moisture not in excess of the amount that will permit uniform distribution and the desired penetration. The prime coat shall be applied only when the ambient temperature is 50 degrees F. or above and when the temperature has not been below 35 degrees F. for 12 hours immediately prior to application, unless otherwise directed.
8. **PREPARATION OF SURFACE.** Immediately before applying the prime coat to the surface that is to be primed, all loose material, contamination, or other objectionable substance shall be removed from the surface by means of a power broom or blower supplemented with hand brooms. After the cleaning operation and prior to the application of the prime coat, an inspection of the area to be primed will be made by the Contracting Officer to determine the fitness of the area to receive the bituminous priming material. To assure a uniform spread of the bituminous material, the portion of the subgrade or base course prepared for treatment, if excessively dry, shall be lightly sprinkled with water immediately before the application, as directed.

9. **APPLICATION OF BITUMINOUS MATERIAL.** Immediately following the preparation of the subgrade or base course, the bituminous material shall be applied by means of a bituminous distributor.

9.1. **PRESSURE AND AMOUNT.** The bituminous material shall be applied at a pressure within the range of 25 to 75 pounds per square inch and in the amounts directed. The priming material shall be applied with uniform distribution at all points of the surface to be treated. Unless the distributor is equipped and operated to obtain satisfactory results at the junction of previous and subsequent applications, building paper shall be spread on the surface of the applied material for a sufficient distance back from the ends of each application so that flow from the sprays may be started and stopped on the paper and so that all sprayers will operate at full force on the surface to be treated. Immediately after the application, the building paper shall be removed and destroyed. All spots unavoidably missed by the distributor shall be properly treated with bituminous material. Following the application of prime material, the surface shall be allowed to dry without being disturbed for a period of 48 hours or longer, as may be necessary to attain penetration into the foundation course and evaporation of the volatiles from prime material, which period shall be determined by the Contracting Officer. The Contractor shall furnish and spread enough approved sand to effectively blot up and cure any excess bituminous material. The Contractor shall maintain the primed surface until the succeeding layer of pavement is placed by protecting the surface against damage and by repairing and repriming deficient areas at no additional cost to the Government. No smoking, fire or flames other than the heaters that are a part of the equipment shall be permitted in the vicinity of heating, distributing, or transferring operations for bituminous materials. The surfaces of structures and vegetation adjacent to the area shall be protected by the Contractor in such manner to prevent their being spattered or marred by bituminous materials.

9.2. **APPLICATION TEMPERATURE FOR LIQUID ASPHALT** shall be as directed and shall provide an application viscosity between 20 and 120 centistokes, kinematic, or 10 and 60 seconds, Saybolt-Furol. Application temperatures shall be within the following ranges, except that appropriate changes should be made when the range of viscosity is raised or lowered:

MC-30	-----	85-155 degrees F.
MC-70	-----	120-190 degrees F.
SS-1, SS-1h, CSS-1, CSS-1h	---	70-160 degrees F.

The temperature-viscosity relationship shall be furnished to the Contracting Officer.

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SECTION 02710
SEWERS; SANITARY, GRAVITY

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

1.1. **FEDERAL SPECIFICATION (Fed. Spec.).**

RR-F-621C Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.2. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.**

- A 123-84 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- C 14-82 Concrete Sewer, Storm Drain, and Culvert Pipe
- C 33-86 Concrete Aggregates
- C 76-85a Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C 94-86b Ready-Mixed Concrete
- C 150-86 Portland Cement
- C 260-86 Air-Entraining Admixtures for Concrete
- C 270-86b Mortar for Unit Masonry
- C 425-86 Compression Joints for Vitrified Clay Pipe and Fittings (R 1982)
- C 443-85a Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- C 478-87 Precast Reinforced Concrete Manhole Sections
- C 700-88 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
- D 2412-87 External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D 2680-87 Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride)(PVC) Composite Sewer Piping
- D 2751-83a Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- D 3034-85b Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D 3212-86 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- F 402-80 Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings

F 949-86a Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

1.3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS.

No. 49-1975 Hazardous Chemicals Data

No. 325M-1984 Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids

No. 704-1985 Standard System for the Identification of the Fire Hazards of Materials

2. **GENERAL.** Gravity sanitary sewers shall be constructed in conformance with this section of the specifications. Installation of force mains shall conform to requirements of SECTION: FORCE MAINS; SEWER. The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the buildings to which the sewer system is to be connected. Reducing fittings shall be provided as necessary to accommodate different pipe sizes. Excavation and backfilling shall conform to SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES. Backfilling shall be accomplished only after inspection and approval of the Contracting Officer. Work covered by this section will not be accepted until backfilling connected with the work has been completed satisfactorily.

3. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit, for approval, data as specified herein on the following:
 - 3.1. **CATEGORY I.** None.
 - 3.2. **CATEGORY II.** (For Information Only)
PVC Pipe

4. **MATERIALS** shall conform to the respective specifications and other requirements specified below:
 - 4.1. **PIPE** may be of any of the following materials unless otherwise specified or shown.
 - 4.1.1. **Plastic Pipe.**
 - 4.1.1.1. **Acrylonitrile-butadiene-styrene (ABS) Composite Piping.** ASTM D 2680, type SC or type OR, size 8-inch through 15-inch diameter.
 - 4.1.1.2. **Acrylonitrile-butadiene-styrene (ABS) Pipe and Fittings.** ASTM D 2751, solvent weld or bell and socket o-ring joint, size 12 inch or less in diameter.
 - 4.1.1.3. **Poly(Vinyl Chloride) (PVC) Pipe and Fittings.** ASTM D 3034, type PSM with a maximum SDR of 35, size 15 inch or less in diameter, with flexible elastomeric seal joint. ASTM F 949 for corrugated sewer pipes with a smooth interior and fittings of 4, 6, 8, and 10 inches in diameter.
 - 4.1.1.4. **Reinforced Plastic Mortar Pipe and Fittings.** Pipe shall conform to ASTM D 3262. Fittings shall conform to ASTM D 3840 and shall be compatible with the pipe supplied. Fittings shall have a strength equal to or greater than the pipe.
 - 4.1.1.5. **Joints.**

- 4.1.1.5.1. **Acrylonitrile-butadiene-styrene (ABS) Composite Pipe.** Type SC or OR, in accordance with ASTM D 2680.
- 4.1.1.5.2. **Acrylonitrile-butadiene-styrene (ABS) Pipe.** Solvent cement or elastomeric joint in accordance with ASTM D 2751, dimensions and tolerances in accordance with Table 2 therein.
- 4.1.1.5.3. **Poly(Vinyl Chloride) (PVC) Pipe.** Elastomeric gasket joint in accordance with the requirements of ASTM D 3212.
- 4.1.1.5.4. **Reinforced Plastic Mortar Pipe.** Elastomeric gasket joints shall comply with the manufacturers' recommendations.

4.1.1.6. **Branch Connections.** Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved by the Contracting Officer. Saddles for acrylonitrile-butadiene-styrene (ABS) composite pipe shall comply with Figure 2 of ASTM D 2680, saddles for acrylonitrile-butadiene-styrene (ABS) pipe shall comply with Table 3 of ASTM D 2751, and saddles for poly(vinyl chloride) (PVC) pipe shall comply with Table 4 of ASTM D 3034.

4.1.1.7. **Protection of Material.** Before, during, and after installation, plastic pipe and fittings shall be protected from exposure to sunlight and any environment that would result in damage or deterioration to the material. 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 will be discarded when the recommended pot life is exceeded.

4.2. **CEMENT MORTAR.** ASTM C 270, type M. Use type IIA cement.

4.3. **PORTLAND CEMENT.** ASTM C 150, type II or air-entrained V for concrete used in manholes. Cement used in concrete cradle and encasement may be Type I.

4.4. **PORTLAND CEMENT CONCRETE.** ASTM C 94. Concrete in place shall be protected from freezing and moisture loss for 7 days and shall conform to SECTION: CONCRETE.

4.5. **PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.** ASTM C 478. Cement used in the manufacture of the precast units shall conform to SECTION: PRECAST, PRESTRESSED CONCRETE UNITS. Joints shall be of mortar, or an approved mastic or rubber gasket, or an approved combination of these.

5. INSTALLATION.

5.1. ADJACENT FACILITIES.

5.1.1. Water Lines.

5.1.1.1. **Horizontal Separation.** Where the location of the sewer is not clearly defined on the drawings, the sewer line shall not be closer horizontally than 10 feet to a water distribution or service line. In cases where this is not practical, a horizontal spacing of 6 feet may be used if the water line is at least a minimum of 12 inches above the top of the sewer pipe. In no case shall water and sewer lines be installed in the same trench.

5.1.1.2. **Crossings.** Where water lines cross either above or below sewer lines, a minimum vertical separation of 18 inches shall be provided. Where a

gravity sewer line crosses above the water line, a 20-foot section of sewer pipe capable of withstanding 15 psi internal pressure, including all joints within this section, shall be centered over the crossing. No joint within this section shall be located closer than 6 feet of the crossing.

5.2. PIPE LAYING.

- a. Pipe shall be protected during handling against impact shocks and free fall and 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 so as to obtain the degree of water tightness required.
- d. ABS composite pipe ends with exposed truss and filler material shall be thoroughly coated with solvent-weld material before making the joint to insure that there will be no water or air passage at the joint between the inner or outer wall of the pipe.
- e. Installations of solvent-weld joint pipe, using ABS or PVC pipe and fittings shall be installed in accordance with ASTM F 402, and all required precautions shall be taken to assure adequate trench ventilation and protection for workers installing the pipe.

5.2.1. 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.

5.2.2. 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. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

5.2.3. 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, is exceeded for any reason other than by direction, the Contractor shall install at no additional cost to the Government such concrete cradling, pipe encasement, or other bedding as may be required to satisfactorily support the added load of the backfill.

5.2.4. Joints Between Different Pipe Materials shall be made as hereinbefore specified, using approved jointing materials.

5.2.5. 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 Standard 704, with classification as indicated in NFPA 49 and NFPA 325M.

5.3. LEAKAGE TESTS. Lines shall be tested for leakage by either infiltration tests or exfiltration tests, as appropriate. Prior to testing for leakage, the trench shall be backfilled up to at least the lower half of the pipe and with sufficient additional backfill 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 0.16 gallon per inch diameter per 100 feet of pipeline per hour. 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.

- 5.4. **TEST FOR DEFLECTION.** When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline on completion of all work, including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Flexible plastic pipe is defined as plastic pipe having a pipe stiffness of less than 150 p.s.i. in accordance with ASTM D 2412. Deflection shall not exceed 5 percent of the base inside pipe diameters listed in ASTM D 3034. Deflection shall be determined by use of a deflection device or by use of a GO/NO GO mandrel. Mandrel dimensions shall be determined as stated in Appendix XI of ASTM D 3034 with a machining tolerance of 0.01 inch. Failure of the mandrel to pass freely through a pipe run shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the mandrel described hereinbefore, such device shall be approved by the Contracting Officer 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 of 5.0 percent shall be retested by a run from the opposite direction. If the retest indicates a deflection in excess of the 5.0 percent, the suspect pipe shall be replaced. Any pipe showing deflections in excess of 5 percent at the end of 1 year following installation and acceptance will be replaced at no cost to the Government.

6. MANHOLES.

- 6.1. **GENERAL.** Manholes shall be constructed of precast concrete rings (see SECTION: PRECAST, PRESTRESSED CONCRETE UNITS), with cast iron frames and covers, and in accordance with the drawings. 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 manholes using water stops, standard o-ring joints, special manhole couplings, or shall be made in accordance with the manufacturer's recommendation. 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 1 foot 6 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels, and drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches. Ladders shall not be installed unless the depth exceeds 12 feet.
- 6.2. **MANHOLE LADDER.** When the depth from top of cover to invert of main sewer exceeds 12 feet, manholes shall be provided with a straight type steel ladder not less than 16 inches in width with 7/8-inch-diameter rungs spaced 12 inches apart. The rails shall be not less than 2 inches by 1/2 inch in section. The ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet apart vertically and shall be so installed as to provide at least 6-1/2 inches of toe space between the wall and the inside of the rungs. The ladder and inserts shall be galvanized after fabrication in conformance with ASTM A 123. The wall along the line of the ladder shall be vertical for its entire height.
- 6.3. **JOINTING AND PLASTERING.** 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.

6.4. **FRAMES AND COVERS.** Cast-iron frames and covers shall conform to Fed. Spec. RR-F-621, type I, size 24A frame with type A, size 24A cover. The frames and covers shall have a combined weight of not less than 400 pounds and shall conform to ASTM A 48, class 20B. The word "sewer", at least 2 inches high, shall be stamped or cast into all covers so as to be plainly visible. Unless otherwise shown on the drawings, the frames and covers shall be so set that the top of the cover will be flush with finished pavement grade or 2 inches higher than finished grade in unpaved areas.

7. **CONNECTIONS TO EXISTING MANHOLES.** Pipe connections to existing manholes shall be made in such a manner that the finished work will conform to the essential applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. All new sewer line penetrations shall be grouted inside and outside of the manhole.

7.1. **EXISTING MANHOLE #103-A.** The bottom of existing manhole #103-A shall be regouted to allow a change in flow direction. The existing outflow line shall be plugged and permanently sealed. The plug shall be a standard rubber compression pipe plug (refer to plans for detail) sized to fit the diameter of the existing pipe. The plug shall be inserted into the existing pipe a maximum of one foot. The wing nut shall be tightened so that the rubber bellow is compressed between the two steel plates and fits securely in the pipe. 3000 psi non-shrink concrete grout shall then be poured into the remaining pipe length (the length between the plug and the inside of manhole #103-A) and hand-tamped to ensure uniform compaction. The exposed surface shall be trowelled smooth. The new 8" gravity sewer line shall be installed at the location and the elevation shown on the plans. Grout shall be placed on the inside and outside of the manhole around the penetration.

7.2. **EXISTING MANHOLE #69.** The new 3" force main shall be connected to existing manhole #69 at the location and the elevation shown on the plans. The pipe penetration shall be grouted inside and outside of the manhole. The bottom shall be regouted to allow for the new flow and shall be directed towards the outflow pipe.

ZERO ACCIDENTS

SECTION 02724
FORCE MAINS; SEWER

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1. **APPLICABLE PUBLICATIONS.** 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.

1.1. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.**

- A 120-84a Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
- C 478-87 Precast Reinforced Concrete Manhole Sections
- D 1785-86 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D 2122-85 Method of Determining Dimensions of Thermoplastic Pipe and Fittings
- D 2146-82 Propylene Plastic Injection and Extrusion Materials
- D 2241-87 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)
- D 2464-76 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D 2564-84 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- D 2774-72 Underground Installation of Thermoplastic Pressure Piping (R 1983)
- D 3035-85 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
- D 3139-84 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- D 3350-84 Polyethylene Plastics Pipe and Fittings Materials
- F 477-76 Elastomeric Seals (Gaskets) for Joining Plastic Pipe (R 1985)

1.2. **AMERICAN WATER WORKS ASSOCIATION (AWWA) STANDARDS.**

- C900-81 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. & Erratum Through 12 In. for Water

1.3. **THE MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS) PUBLICATION.**

2. **TESTING.** Testing shall be the responsibility of the Contractor. Testing shall be performed by an approved independent testing laboratory or by the Contractor subject to approval. The test may be witnessed by the Contracting Officer. The Contracting Officer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Contracting Officer within 30 days of the test.
3. **DELIVERY AND STORAGE.** All materials delivered and stored shall be handled and stored in such a manner that pipe, fittings and accessories, and pipe coatings are not damaged.
4. **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.
5. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit for approval, data as specified herein on the following:
 - 5.1. **CATEGORY I.** (None)
 - 5.2. **CATEGORY II.** (For Information Only)
 - Manufacturer's Instructions (Para. 6)
 - Manufacturer's Data (Para. 6)
 - Hydrostatic Tests (Para. 8)
 - Final Test Reports (Para. 8)
6. **MATERIALS.**
 - 6.1. **PIPE AND FITTINGS.**
 - 6.1.1. **General**
 - 6.1.1.1. **Less Than 4 Inches.** Buried piping shall be polyvinyl chloride (PVC), polyethylene (PE), or polypropylene pipe. Piping installed in pump stations shall be galvanized steel.
 - 6.1.2. **Steel Pipe and Fittings.**
 - 6.1.2.1. **Pipe.** ASTM A 120, standard weight galvanized with threaded joints.
 - 6.1.2.2. **Fittings.** ANSI B16.3, galvanized.
 - 6.1.3. **Polyvinyl Chloride (PVC) Pipe and Fittings.**
 - 6.1.3.1. **PVC Pipe Fittings.**
 - 6.1.3.1.1. **PVC Pipe and Fittings Less Than 4 Inches in Diameter.** ASTM D1785, Schedule 80 with screw joints, or D2241, SDR 26, with push-on joints or solvent weld joints.
 - 6.1.3.2. **Screw Joint Fittings.** ASTM D 2464, Schedule 80.
 - 6.1.3.3. **Push-On Joint Fittings.** ASTM D 3139, with ASTM F 477 gaskets.
 - 6.1.3.4. **Solvent Cement.** ASTM D 2564.

6.1.3.5. Couplings for use with plain end pipe shall have centering rings or stops to insure the coupling is centered on the joint.

6.1.4. Polyethylene (PE) Pipe and Fittings.

6.1.4.1. **PE Pipe and Fittings.** ASTM D 3350 and D 3035, minimum pressure rating of 100 psi at 73.5 degrees F.

6.1.4.2. **Heat Fusion Joints.** ASTM D 2657.

6.1.4.3. **Flanged Joints.** ANSI B16.1 or AWWA C207.

6.1.4.4. **Mechanical Joints.** ANSI B16.1.

6.1.5. Polypropylene Pipe and Fittings.

6.1.5.1. **Polypropylene Pipe and Fittings.** ASTM D 2122 and ASTM D 2146.

6.1.5.2. **Heat Fusion Joints.** ASTM D 2657.

6.2. VALVES.

6.2.1. **Check Valves.** Check valves shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. The body shall be iron. Directly cast on the body shall be the manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow.

6.2.1.1. **Ball Check Valves.** Valves shall be iron body, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125-pound type complying with ANSI B16.1. Ball shall be stainless steel unless otherwise specified.

6.2.2. **Plug Valves.** MSS SP-78, non-lubricated type, regular pattern with resilient plug facing of Buna N, Hycar, or other material resistant to hydrocarbons. Valves installed in pump stations or valve vaults shall be provided with lever operators and position indicators. Buried valves shall be provided with operating nuts. All exposed bolts and nuts shall be zinc-plated or stainless steel.

6.2.3. **Air Release Valves.** Air release valves shall be designed to permit release of air from an empty pipe during filling and shall be capable of discharging accumulated air in the line while the line is in operation and under pressure. Valves shall be attached by means of threaded pipe connections. Valves shall be vented to the atmosphere. Automatic air release valves shall be used unless otherwise indicated.

6.2.3.1. **Automatic Air Release Valve.** Automatic air release valves shall be of the compound lever type capable of withstanding operating pressures of 150 psi. The valves shall have a 1/2-inch outlet. The body and cover of the valve shall be of iron with a stainless steel float. All internal parts shall be stainless steel or bronze. The valve shall be specifically adapted for use with sewage. Each valve shall be complete with hose and blow-off valves to permit backflushing without dismantling the valve.

6.3. **AIR RELEASE MANHOLE.** Air release manhole shall be precast concrete manhole sections (see SECTION: PRECAST, PRESTRESSED CONCRETE UNITS). The boxes shall be of such length as will be adapted, without full extension, to the depth of cover over the pipe at the valve locations. The word "Sewer" shall be cast in the cover.

- 6.4. **VALVE VAULTS.** Valve vaults shall be precast concrete units conforming to ASTM C 478 or cast-in-place as shown on the drawings. Concrete for cast-in-place structures shall conform to the SECTION: PRECAST, PRESTRESSED CONCRETE UNITS.
- 6.5. **MISCELLANEOUS MATERIALS.** Miscellaneous materials shall comply with the following requirements.
- 6.5.1. **Joint Lubricants.** Joint lubricants shall be as recommended by the pipe manufacturer.
- 6.5.2. **Bolts, Nuts and Glands.** ANSI A21.11.
- 6.5.3. **Bond Wire.** Type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.
7. **INSTALLATION.** All pipe, pipe fittings, and appurtenances installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in SECTION: EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.
- 7.1. **UTILITY SEPARATION.** Pressure sewer pipe and water pipe shall be separated at least 10 feet horizontally. If conditions prevent 10 feet separation, a minimum of 6 feet horizontal distance shall be provided along with a minimum vertical separation of 12 inches from the bottom of the water pipe to the top of the pressure sewer pipe. Where pressure sewer pipe must cross water pipe, pressure sewer pipe shall always cross beneath water pipe. A vertical distance of 2 feet between the bottom of water pipe and the top of pressure sewer pipe shall be maintained. The force main joints shall not be closer than 3 feet horizontally to the point of crossing.
- 7.2. **CUTTING.** Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying except as otherwise specified.
- 7.3. **LAYING.** Except where authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with the following:
- 7.3.1. **Polyvinyl Chloride.** Manufacturer's instructions.
- 7.3.2. **Polyethylene.** ASTM D 2774.
- 7.3.3. **Polypropylene.** ASTM D 2774.
- 7.3.4. **Reinforced Thermosetting Resin.** Manufacturer's instructions.
- 7.3.5. **Reinforced Plastic Mortar.** Manufacturer's instructions.
- 7.4. **JOINTING.**
- 7.4.1. **Polyvinyl Chloride Pipe.**
- 7.4.1.1. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joint shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than two threads past hand-tight.

- 7.4.1.2. The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to insure that the gasket remains in proper position in the bell or coupling while making the joint.
- 7.4.1.3. Solvent-weld joints shall comply with the manufacturer's instructions.
- 7.4.2. **Polyethylene Pipe.** Heat fusion joints shall be made in compliance with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time. Flanged and mechanical joints shall be made in compliance with the manufacturer's instructions.
- 7.4.3. **Polypropylene Pipe.** Heat fusion joints shall be made in compliance with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time.
- 7.5. **VALVES.** Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and closed to insure that all parts are properly operating. Valves shall be installed with the stem in the vertical position. Valves shall be installed in valve vaults as indicated.
- 7.6. **AIR RELEASE MANHOLES.** Air release manholes shall be installed over each outside air release valve, unless otherwise indicated. Air releases manhole shall be centered over the valve. Fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.
- 7.7. **VALVE VAULTS.** Valve vaults shall be installed as indicated.
- 7.8. **DRAIN LINES.** Drain lines shall be installed where indicated. The drain line shall consist of a tee in the main line with a 4-inch diameter branch, a 4-inch diameter elbow, and a 4-inch plug valve.
- 7.9. **BONDED JOINTS.** For ferrous piping, a metallic bond shall be provide at each joint, including joints made with flexible couplings, caulking or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond shall be of the thermal weld type. Test leads shall be provided in accordance wit the details shown on the drawings. Test leads shall be placed at intervals not exceeding 300 feet, on pipe casings, and where the pipe crosses within 6 inches of any other metal pipe (Provide 2 test leads, one each pipe). Test leads will not be required within 300 feet of a riser pipe or any other place where the pipe may be readily accessible. The Contractor shall provide a plan showing dimensioned location of all test leads. Test leads and bond connections shall be made with the exothermic weld process, insulated with coal tar base mastic and protected with a weld shield or a plastic weld cap.
8. **HYDROSTATIC TESTS.** The pipeline shall be subjected to both a pressure test and a leakage test.
- 8.1. **PRESSURE TEST.** After the pipe has been installed, joints completed, thrust blocks have been in place for at lest 5 days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with water in a manner to expel all air. The pipeline shall be subjected to a test pressure of 100 psi or 150 percent of the working pressure, whichever is greater, for a period of at least 1 hour. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced.
- 8.2. **LEAKAGE TEST.**

8.2. LEAKAGE TEST.

8.2.1. The leakage test may be conducted subsequent to or concurrently with the pressure test.

8.2.2. The amount of water permitted as leakage for the line shall be placed in a sealed container attached to the supply side of the test pump. No other source of supply will be permitted to be applied to the pump or line under test. The water shall be pumped into the line by the test pump as required to maintain the specified test pressure as described for pressure test for a 2-hour period. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure.

8.2.3. Leakage considered acceptable shall be less than the number of gallons per hour as determined by the following formula:

$L = ND P/K$ Where:

L = Allowable leakage in gallons per hour.

N = Number of joints in length of pipeline tested.

D = Nominal diameter of the pipe in inches.

P = Square root of the test pressure in psig.

K = 7400 for pipe materials.

8.2.4. At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

8.3. **RETESTING.** If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are within specified allowances without additional cost to the Government.

ZERO ACCIDENTS

SECTION 03303
CONCRETE

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

1.1 **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATIONS.**

A 185-85	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
A 615-87	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C 33-86	Concrete Aggregates
C 94-86b	Ready-Mixed Concrete
C 150-86	Portland Cement
C 231-87	Air Content of Freshly Mixed Concrete by the Pressure Method

1.2 **AMERICAN CONCRETE INSTITUTE (ACI) STANDARD.**

ACI 301-1984 Specifications for Structural Concrete for Buildings

2. **GENERAL.** Concrete construction covered by this section consists of all required concrete construction including pavement slabs, curb repairs, manholes, footings, and miscellaneous works. Concrete shall be an approved mixture of portland cement, water, fine and coarse aggregate. The mixture shall be proportioned for a minimum cement content of 564 pounds per cubic yard. All concrete used, except for roadway and curb repairs, shall have a minimum compressive strength of 3000 psi at 28 days. The concrete used for roadway and curb repair shall have a minimum compressive strength of 4000 psi at 28 days. Where pre-cast manholes are used, refer to SECTION: PRECAST, PRESTRESSED CONCRETE UNITS. All concrete shall have a slump between 2 and 4 inches. An approved air-entraining admixture shall be batched in the mixture in proper proportions to produce a total air content between 4 and 7 percent of the volume of the concrete when determined in accordance with the requirements of ASTM C231.

3. **MATERIALS.**

3.1 **CEMENT.** Cement shall be Portland cement conforming to the requirements of ASTM C 150, Type I or II, low alkali.

3.2 **AGGREGATES.** Fine and coarse aggregates shall conform to the requirements of ASTM C 33. Maximum size of coarse aggregate shall be 3/4-inch.

3.3 **WATER** shall be potable water.

- 3.4 **REINFORCING.** Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60. No welding shall be performed on reinforcing steel. Welded wire fabric shall conform to the requirements of ASTM A 185.
4. **CONCRETING OPERATIONS.** Batching, mixing, conveying, placing, forming, finishing, curing and protection of concrete, and placing of reinforcement shall conform to the requirements of American Concrete Institute Standard "Specifications for Structural Concrete for Buildings," ACI-301, and shall be subject to approval, except that all concrete shall be consolidated with mechanical internal vibrators and that only floated, troweled, or broomed finish, as directed, will be required for unformed surfaces. Ready-mixed concrete, if used, shall conform to the requirements of ASTM C 94.
5. **CONTRACTOR'S QUALITY CONTROL.** Quality control sampling and testing shall be performed by the Contractor in accordance with paragraph: CONTRACTOR QUALITY CONTROL in SECTION: SPECIAL CLAUSES and as specified herein. The Government may perform verification tests as considered necessary but this will in no way relieve the Contractor of his quality control sampling and testing responsibility.

ZERO ACCIDENTS

SECTION 03411
PRECAST, PRESTRESSED CONCRETE UNITS

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1. **APPLICABLE PUBLICATIONS.** The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto.

1.1. **U. S. ARMY CORPS OF ENGINEERS HANDBOOK FOR CONCRETE AND CEMENT (SPECIFICATIONS AND METHODS OF TESTS).**

- CRD-C 13-79 Air-Entraining Admixtures for Concrete
- CRD-C 200-79 Cement and Pozzolan, General Requirements for
- CRD-C 619-81 Grout Fluidifier

1.2. **U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS PUBLICATION.**

- Product Standard Construction and Industrial Plywood
PS 1-83

1.3. **AMERICAN CONCRETE INSTITUTE STANDARDS.**

- ACI 318-83 Building Code Requirements for Reinforced
Concrete with Commentary

1.4. **AMERICAN SOCIETY FOR TESTING AND MATERIALS PUBLICATIONS.**

- A 82-85 Steel Wire Plain, for Concrete Reinforcement
- A 185-85 Steel Welded Wire Fabric Plain, for Concrete Reinforcement
- A 416-86 Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete
- A 421-80 Uncoated Stress-Relieved Steel Wire for Prestressed Concrete (R-1985)
- A 615-85 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- C 31-85 Making and Curing Concrete Test Specimens in the Field
- C 33-86 Concrete Aggregates
- C 39-86 Compressive Strength of Cylindrical Concrete Specimens (CRD-C 14)
- C 138-81 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- C 192-81 Making and Curing Concrete Test Specimens in the Laboratory

- C 231-82 Air Content of Freshly Mixed Concrete by the Pressure Method
- C 289-81 Potential Reactivity of Aggregates Chemical Method)
- C 330-87 Lightweight Aggregates for Structural Concrete
- C 494-86 Chemical Admixtures for Concrete

1.5. CONCRETE PLANT MANUFACTURERS BUREAU.

Concrete Plant Standards (December 1, 1977) (CRD-C 95-77)

1.6. PRESTRESSED CONCRETE INSTITUTE PUBLICATION.

MNL-116-85 Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products

2. **GENERAL.** The contract drawings indicate the extent of use, general arrangement of the precast concrete units, and the results required.
- 2.1. **EXTENT OF WORK.** This section covers design, fabrication, testing, delivery, and erection of precast concrete units, both prestressed and non-prestressed, consisting of: Manhole Sections, Manhole Vaults and Valve Vaults.
- 2.2. **STANDARD PRODUCTS.** Precast concrete units to be provided shall be products of a manufacturer regularly engaged in the production of similar precast concrete units. The fabrication plant shall be a permanently established off-site plant. Regardless of the production method or type of plant, precast concrete units shall be (standard shape), machine made concrete units produced under a rigid factory inspected process requiring molding in dimensionally stable forms. Selection of the manufacturer and the fabricating plant for the precast units shall be subject to the specific approval of the Contracting Officer. The precast concrete units shall conform to the details and dimensions shown on the drawings. However, minor variations in details, shape, and dimensions to conform to the fabricator's standard products will be permitted, subject to specific approval, provided the load-carrying capacity of the proposed alternate is not less than the capacity of the units indicated on the drawings and conforms in all respects to the requirements of paragraph: DESIGN, except that the depths and spacing of the units shall be as shown. Subject to specific approval, prestressed units may be substituted for non-prestressed units, provided the units are of standard manufacture and meet all other requirements of the plans and specifications.
- 2.3. **RESPONSIBILITY FOR COORDINATION OF THE WORK.** The Contractor shall visit the project site, familiarize himself with the details of the work and working conditions, verify the dimensions at the project site, and advise the Contracting Officer of any discrepancy before performing the work. The Contractor shall be responsible for the coordination and proper relation of the work to the structure and to the work of all trades. The prime Contractor shall check all fabrication and erection drawings to insure their conformance with the overall structural dimensions, and shall resolve any conflicts between the precast/prestressed concrete work, his work and that of other trades, prior to submittal of the shop drawings.
- 2.4. **CONCRETE STRENGTH (AND UNIT WEIGHT).** The specified 28-day compressive strength of the concrete in the precast, non-prestressed, concrete units shall be a minimum of 3,000 p.s.i.
3. **MATERIALS.** Except as otherwise specified herein, concrete, concrete materials, and other materials required in the units, together with requirements of sampling, testing, and submittal of certifications and certified test results, shall conform in all respects to the requirements therefor specified in SECTION: CONCRETE, irrespective of the method used for casting units or the particular type of fabricating or prestressing system used.

- 3.1. **PORTLAND CEMENT** shall conform to the quality requirements specified in SECTION: CONCRETE.
 - 3.2. **AGGREGATES** shall conform to the requirements specified in SECTION: CONCRETE, or, at the Contractor's option, shall conform to the requirements of ASTM Standard C 33. Maximum size of coarse aggregate shall be 3/4 inch, or as otherwise approved. Alternate gradations, different from those specified in the above-named references, may be used, subject to approval.
 - 3.3 **ADMIXTURES.**
 - 3.3.1. Air-entraining Admixtures shall conform to the requirements of Corps of Engineers Specification CRD-C 13.
 - 3.3.2. Other Admixtures in addition to air-entraining admixtures may be used subject to specific approval of type and brand. Admixtures other than air-entraining agents shall conform to the requirements of ASTM Standard C 494. If an admixture other than air-entraining admixture is proposed for use, the Contractor shall submit a certification stating that the admixture does not contain a chloride ion. In no case shall calcium chloride or an admixture containing calcium chloride be used in prestressed concrete.
4. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit for approval items as listed in the following categories.
- 4.1. **CATEGORY I.** Submitted for review and approval.
 - 4.1.1. Design Computations and Fabrication and Erection Drawings. At least 30 days prior to casting the units, the Contractor shall submit for approval complete design computations fabrication and erection drawings and placement diagrams for the precast units in accordance with the SPECIAL CLAUSES and shall submit such other descriptive data as the Contracting Officer may require to demonstrate compliance with the contract requirements. The submittal shall also include the Contractor's proposed methods of curing and storing the units in the casting yard and complete details of the method of casting, handling, transporting, and erecting the units, including type and location of lifting devices, and all details of the prestressing system and procedures. If departures from the contract drawings are deemed necessary by the Contractor or if the Contractor proposes to make minor variations in the details and dimensions of the units, as permitted by subparagraph: Standard Products, the Contractor shall prove to the satisfaction of the Contracting Officer that the size and shape of section and the reinforcement provided, both prestressed and non-prestressed, will produce units of the same structural quality as, or higher than, the units indicated on the plans, and the units will function properly with each other and with other parts of the structure. Variations shall be made at no additional cost to the Government. In addition, the Contractor shall at the same time submit details for all connections which are proposed and which vary from or are not included in the contract drawings. (Fabrication and erection drawings shall contain floor plans, details (including all embedded items), and the size and location of every blackout required for any opening in each unit. Openings include those necessary for mechanical or electrical work, columns or any other major physical interference. At the Contractor's option, holes less than 6-inch diameter may be field drilled, in compliance with criteria shown on the fabrication and erection drawings but must not interrupt webs of slab units.) Fabrication and erection drawings and placement diagrams for all units shall be submitted at one time. No casting operations shall commence until design computations, fabrication and erection drawings and placement diagrams have been approved.
 - 4.2. **CATEGORY II.** Submitted for information only.
 - 4.2.1. Certifications, Including Certified Test Results. Prior to use of each of the following materials, the Contractor shall submit, in accordance with SECTION: SPECIAL

CLAUSES, Certificates of Compliance or Certified Test Results, as listed, for each lot of material shipped to the project showing that the materials conform to all requirements specified, each of which shall be clearly identified by designated name of material and batch or lot number. Certificates of Compliance and Certified Test Results shall be furnished regardless of any requirements for submission of samples.

4.2.1.1. Certification of Compliance.

Portland cement
Aggregates
Curing compound
Reinforcing bars and dowels
Welded wire fabric
Ducts

4.2.1.2. Certified Test Results. Tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturer or producer of the material. The laboratory making the tests shall certify that the test results are valid and that the tests were made in compliance with the test methods specified.

Aggregates, lightweight
Air-entraining admixture
Admixtures other than A.E.A.
Grout fluidifier

If approved, in lieu of submitting such test results the Contractor shall have available for inspection at the fabricating plant, and shall so notify the Contracting Officer, prior to use of each material, or new lot of each material, certified test results showing that all such material on hand in the plant conforms to all requirements specified.

5. TESTING, MIX DESIGNS, AND QUALITY CONTROL. Except as otherwise specified herein, all sampling and testing of materials shall be conducted in accordance with the requirements contained in the applicable referenced standards under which the respective material is furnished.

5.1. TESTING. Sampling and testing of all materials and end items shall be the responsibility of the Contractor. Sampling and testing shall include fabricating, curing and testing specimens required for strength evaluation of concrete. Verification tests, if made by the Government of any material, shall in no way relieve the Contractor from the testing responsibilities specified herein.

5.2. QUALITY CONTROL. All quality control sampling, testing and inspection shall be performed by the Contractor in accordance with paragraph: Contractor Quality Control in SECTION: SPECIAL CLAUSES and as specified herein. Except as otherwise specified herein, the Contractor shall provide quality control measures equivalent to those listed in Division V of the "Manual for Quality Control" of the Prestressed Concrete Institute.

5.3. TESTING AGENCY. The testing and mix design studies specified herein shall be performed by an approved commercial testing laboratory or, if specifically approved in writing, by a laboratory maintained by the fabricator of the precast units.

5.4. CONCRETE MIX DESIGN STUDIES. The strength quality of the concrete proposed for use in the various types of precast units shall be established by mix designs which shall be the responsibility of the Contractor using the materials proposed for use in fabricating the units. At least 15 days prior to commencing fabrication operations the Contractor shall submit for approval the design of the concrete mixes to be used. The concrete mixes shall be designed in accordance with Sections 4.2, 4.3 and 4.5 of ACI 318 using the specified strength(s) (for the various units) given in subparagraph: Concrete Strength. The mix design(s) to be used shall be based on the results of these separate mix design studies or may consist of similar data previously obtained during actual fabrication operations involving the same materials proposed

for use under this contract. The mix design submitted for approval shall consist of certified test results from the approved testing laboratory showing that at least four test specimens were fabricated for 28-day tests from one batch of concrete of the mix proposed for use and that all specimens fabricated for 28-day tests were tested and attained an average strength as required above. The mix design shall show the proportions of all ingredients in the mix proposed for use plus the unit weight, slump and air content of the fresh concrete. No variations in the mix or in the sources of materials from those in the approved mix design shall be made unless approved in writing by the Contracting Officer.

5.5. CONCRETE TEST METHODS.

5.5.1. Concrete Test Specimens. For mix design studies, concrete test specimens shall be fabricated and cured in accordance with the requirements of ASTM Standard C 192, except as modified hereinafter. For concrete control tests, concrete test specimens shall be fabricated and cured in accordance with the requirements of ASTM Standard C 31 using "Field-cured Specimens" procedures as specified therein with the following modifications. Samples for fabricating test specimens shall be taken as concrete is discharged into the forms. Except as otherwise specified for 28-day strength test specimens for control tests, all specimens shall be stored adjacent to the precast units at all times prior to movement to laboratory storage and shall be cured in the same manner as the units represented. When precast units are moved from the precasting yard prior to 28-day age, as specified in subparagraph: Optional Movement of Units at Early Age, the 28-day strength test specimens shall be moved, as necessary, immediately before the precast units are removed from the yard and shall be stored for the remainder of the 28-day period, until time for movement to laboratory storage, at an approved location in the precasting yard where they will be exposed to direct sunlight and to the elements. Test specimens for mix design studies and for control tests shall be molded in reusable molds of heavy gage metal with machined metal base plates which can be tightly secured to the mold. Testing shall be performed in accordance with the requirements of ASTM Standard C 39. Included with each set of test results submitted shall be certificates from the laboratory that the test specimens were fabricated, cured and tested in accordance with these specifications.

5.5.2. Alternate Test Methods. Alternate test methods such as will not be accepted for evaluating the concrete in the precast units except as specified herein. Results of tests made with impact test hammers, ultra-sonic test equipment or other nondestructive testing equipment will not be accepted for evaluating the concrete.

5.5.3. Tests to Determine Air Content of fresh concrete shall be made in accordance with the requirements of ASTM Standard C 231 and shall be made on samples taken as the concrete is discharged into the forms.

5.5.4. Tests to Determine Unit Weight of Fresh Concrete shall be made in accordance with the requirements of ASTM Standard C 138 and shall be made on samples taken as the concrete is discharged into the forms.)

5.5.5. Tests to Determine 28-day, Air-dry Unit Weight of Concrete shall be made in accordance with the procedures contained in ASTM Standard C 330.)

6. CONCRETE.

6.1. GENERAL. Concrete in the precast units will be accepted on the basis of the results of 28-day compressive strength control tests evaluated in accordance with Section 4.7.2.3 of Chapter: CONCRETE QUALITY of ACI 318. Any unit or group of units in which individual strength test falls more than 500 psi below the specified strength shall be rejected and replaced. All rejected units shall be replaced with satisfactory units at no additional cost to the Government.

6.2. PROPORTIONING OF CONCRETE. Concrete shall be proportioned by weight. The concrete mix for initial fabrication operations shall be as determined in accordance with the requirements of subparagraph: Concrete Mix Design Studies. After the results of 28-day compressive

strength tests made in accordance with the requirements of subparagraph. Concrete Control Tests become available, the mix proportions may be adjusted as approved. If at any time the results of 28-day compressive strength tests fail to meet the requirements of subparagraph: General, above, the concrete mix shall be immediately adjusted, as approved. Concrete with standard weight aggregate in the precast vault units shall be air-entrained concrete with a total air content between 4 and 7 percent by volume of concrete. At the Contractor's option, concrete with standard weight aggregate in other precast units may be air-entrained, with the same air content.

- 6.3. **CONCRETE PRODUCTION.** Concrete batching, mixing, conveying, placing and consolidating equipment and procedures shall conform to the requirements therefor specified in SECTION: CONCRETE except that a manual batching plant as defined in the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau may be used. Concrete in the precast units shall be thoroughly consolidated by means of internal type mechanical vibrators, supplemented as necessary by use of form vibrators, hand-spading and tamping.

7. REINFORCEMENT.

- 7.1. **GENERAL.** The reinforcement shall be of the size, design and spacing indicated on the approved shop drawings. All reinforcement shall be securely held in indicated position by means of approved supports, spacers, ties, or other positive and rigid spacing devices which will properly maintain the reinforcement in position during placing of concrete. Welding of reinforcement or welding for reinforcement, including tack-welding for support, will not be permitted. All reinforcing steel shall be free of dirt, grease, oil, paint, form release agents, loose rust and other deleterious materials at the time concrete is placed. Light coatings of surface rust will be permitted. Reinforcing bars shall not be spliced at points of maximum stress. Laps and splices in reinforcing bars shall be made in conformance with the American Concrete Institute Building Code Requirements for Reinforced Concrete, ACI 318. Welded wire fabric shall be spliced by lapping at least one full mesh.

7.1.1. **Welding of Reinforcement.** Welding of reinforcement shall not be allowed.

- 7.2. **TOLERANCE FOR PLACING REINFORCING STEEL.** Reinforcing steel shall be placed at the locations shown on the approved fabrication and erection drawings, within the following tolerances:

Variation of protective covering of reinforcing bars (and spiral steel) $\pm 1/4$ inch

Variation from indicated spacing of reinforcing bars (and spiral steel) $\pm 3/4$ inch
Variation of protective covering of welded wire fabric $\pm 3/8$ inch

8. FABRICATION REQUIREMENTS.

- 8.1. **BLOCKOUTS** and preformed holes shall be accurately formed by approved means. Method of forming blockouts and holes shall be shown on the fabrication and erection drawings submitted for approval.
- 8.2. **MARKING.** All precast units shall be plainly marked and identified so as to provide ready correlation with concrete test specimens representing the units. Pickup points shall be plainly marked on all units. Units shall be marked to identify the top side and the position on the placement drawings. Units designed specifically to be erected adjacent to each other and to function together shall be plainly match-marked, before removal from the casting bed, to definitely indicate the related units to be joined and the exact position for assembly.
- 8.3. **ERECTION ACCESSORIES** shall be embedded in the precast units as shown on the approved fabrication and erection drawings.

9. **CURING AND PROTECTION** shall conform to the requirements therefor specified in SECTION: CONCRETE, except that accelerated curing may be employed as specified herein and that membrane forming curing compound shall not be used.

9.1. **ACCELERATED CURING.** Accelerated curing procedures such as high pressure steam, steam vapor, radiant heating or other generally accepted processes used to accelerate the strength gain of concrete may be employed subject to approval of the entire process. If such a process is used, the curing time may be reduced as approved. If accelerated curing is employed, there shall be no retrogression of strength from the end of curing to 28-day age. If accelerated curing is proposed, the Contractor shall furnish data from previous fabricating operations to demonstrate that the above requirements will be met or, if directed, shall fabricate, cure, and test a sufficient number of concrete test specimens during fabrication operations to demonstrate that the above requirements will be met. If steam is used for curing, it shall be 100 percent relative humidity and steam jets shall be positioned so as not to discharge directly on the concrete or forms. Steam curing shall be commenced not less than two hours and not more than five hours after completion of concrete placing. In cold weather, during this presteam period the concrete and the ambient air shall be maintained at a temperature between 50 and 70 degrees F. During application of steam, the temperature of the ambient air about the concrete shall not be allowed to change more than 20 degrees F. per hour and during discontinuance, not more than 40 degrees F. per hour. Maximum allowable temperature of the ambient air about the concrete shall be 180 degrees F. Arrangement of steam jets and covers shall be such as to insure that the unit has a uniform temperature throughout and, insofar as possible to expose all surfaces of the units or the forms to the steam. If radiant heating is used for curing, all surfaces of the concrete shall be kept moist during the curing period, either by application of moisture or by completely and positively sealing surfaces against loss of moisture by approved means. Curing compound shall not be used for this application. If radiant heating is used, the arrangement of all heating elements and covers shall be such as to insure that the concrete unit has a uniform temperature throughout and to particularly insure that no surfaces are exposed to ordinary atmospheric temperatures during the heating period. Application time and temperature requirements specified above for steam curing shall also apply to radiant heat curing. If accelerated curing is used, recording thermometers showing the time-temperature relationship during the entire curing period shall be used. At least one thermometer shall be used for each 200 feet of bed. A temperature log shall be maintained during all curing operations and shall be available for inspection by the Contracting Officer at all times.

9.2. **HANDLING, STORING, TRANSPORTING AND ERECTING UNITS.** Procedures proposed for handling, storing, transporting and erecting precast units, including the design and location of any proposed lifting devices, shall be submitted in detail, in accordance with subparagraph: Fabrication and Erection Drawings, for approval before units are cast. No variation from the approved except with prior specific approval. All lifting shall be by means of lines attached at the designated pickup points. Except as otherwise specified in the following subparagraph, the precast units shall not be removed from the precasting yard until 28-day age and until the Contractor has submitted certified results of tests for 28-day compressive strength, as specified in paragraph: TESTING, MIX DESIGNS AND QUALITY CONTROL, showing that the required strength has been attained. The units shall be so transported and handled as to prevent cracking, spalling and other damage. Handling and conveying of units in the precasting yard before completion of curing operations shall be kept to a minimum and shall be done with machinery designed to prevent bending or shock to the units.

9.3. **TRANSPORTING UNITS.** The precast units shall be so transported and handled as to prevent tipping or racking of the units and to prevent over-stressing from jars and shocks. The units shall be supported at pickup points and shall be blocked and tied in an approved manner during transporting and erecting.

9.4. **ERECTING UNITS.** All supporting procedures used during erection shall conform to the approved procedures and shall be such as to insure that the final alignment of all units after all operations are complete will be as indicated and specified. Units shall not be loaded during erection nor shall force be used in any way to attain the required construction tolerances between erected units.

10. **DESIGN.** The precast concrete vault units shall be designed to meet the following requirements:
Earth Pressure and Handling Loads.

10.1. **GENERAL.** The precast units shall be designed for the loads indicated on the drawings. The design shall be accomplished by a Registered Professional Engineer, who can demonstrate previous experience in the design of structural elements similar in shape and span. The design computations, which shall be submitted to the Contracting Officer for review and approval, as specified in paragraph: Fabrication and Erection Drawings, shall conform with the requirements of the (American Concrete Institute Building Code Requirements for Reinforced Concrete, ACI 318, Prestressed Units) (Sec. 6 of the AASHTO Standard Specifications for Highway Bridges, Bridge Units).

ZERO ACCIDENTS

SECTION 05500
MISCELLANEOUS METAL

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1. **APPLICABLE PUBLICATIONS.** 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.

1.1. **FEDERAL SPECIFICATIONS.**

L-S-125B	Screening, Insect, Nonmetallic
FF-S-85C & AM-1	Screw, Cap, Slotted and Hexagon Head
FF-S-92B & AM-1	Screw, Machine: Slotted, Cross-Recessed or Hexagon Head
FF-S-111D	Screw, Wood
FF-S-325 & Int. Am-3	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, (GSA-FSS) Anchoring, Masonry)
FF-W-84a & Am-3 & Am-3	Washers, Lock (Spring)
QQ-F-461c & Am-1 & Am-1	Floor Plate, Steel, Rolled
QQ-S-763E	Steel Bars, Wire, Shapes, and Forgings, Corrosion-Resisting
QQ-S-766c & Int. Am-6	Steel Plates, Sheets, and Strip - Corrosion Resisting
RR-G-661D	Grating, Metal, Bar Type (Floor, Except for Naval Vessels)
RR-G-1602B	Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)
RR-S-001301	(FAA) Safety Equipment, Climbing
RR-W-365A & Int. Am-1	Fabric (Insect Screening)
TT-V-51F	Varnish; Asphalt

1.2. MILITARY SPECIFICATIONS.

MIL-M-17194D Metal, Expanded, Steel

MIL-C-18480B Coating Compound, Bituminous, Solvent, Coal Tar Base

1.3. AMERICAN INSURANCE ASSOCIATION (AIA) PUBLICATION.

National Building Code (1976; Amendments Dec 1977)

1.4. AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI) STANDARD.

A 14.3-1984 Safety Requirements for Fixed Ladders

1.5. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS.

A 36-84a Structural Steel

A 48-83 Gray Iron Castings

A 53-86 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

1.6. AMERICAN WELDING SOCIETY (AWS) STANDARD.

D1.1-86 Structural Welding Code - Steel

1.7. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS.

No. 101-1985 Code for Safety to Life from Fire in Buildings and Structures

No. 211-1984 Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

1.8. WOVEN WIRE PRODUCTS ASSOCIATION (WWPA) PUBLICATION.

Woven Wire: Protection and Security (1977)

2. GENERAL. The following general requirements shall apply to all miscellaneous metal items unless otherwise noted or specified.

2.1. FABRICATION. The Contractor shall verify all dimensions and shall take necessary field measurements before fabrication. Design and fabrication details of all items shall be such as to provide adequate strength and stiffness.

2.2. SIZES AND GAGE shall be no smaller or lighter than those specified hereinafter, but slightly larger or heavier sizes and gages will generally be acceptable. Gages of materials shall be manufacturers standard gage.

2.3. GALVANIZING. Items specified to be galvanized shall be hot-dip processed after fabrication. Galvanizing shall be in accordance with ASTM A 123, A 386, or A 525, as applicable.

2.4. FASTENERS. All exposed-to-view fasteners shall generally match in color and finish, and shall harmonize with the material to which fasteners are applied.

2.5. COMPLETENESS. Materials, parts, bolts, anchors, supports, braces, and connections necessary for completion of the work shall be provided even though not precisely shown or specified. The necessary rebates, lugs and brackets shall be provided so that the work can be assembled in a neat and rigid manner.

2.6. INSTALLATION. Holes for bolts and screws shall be drilled or neatly punched. Poor matching of holes shall be cause for rejection of the work. Fastenings shall be concealed where

practicable. Assembly and installation shall provide ample strength to completed installation. Joints exposed to the weather shall be formed to exclude water.

- 2.7. **CORROSION PROTECTION - DISSIMILAR MATERIALS.** Contact surfaces between dissimilar metals and aluminum surfaces in contact with concrete, masonry, pressure-treated wood or absorptive materials subject to wetting, shall be given a protective coating conforming to Military Specification MIL-C-18480 or to Fed. Spec. TT-V-51.

3. **MATERIALS** shall conform to the requirements specified for the particular item; and where these requirements are not specified in detail, the materials shall be suitable for the intended usage of the item.
 - 3.1. **ANCHORS.**
 - 3.1.1. **Expansion Shields.** Fed. Spec. FF-S-325.
 - 3.1.2. **Toggle Bolts.** Fed. Spec. FF-B-588.
 - 3.2. **EXPANDED METAL** shall conform to Military Specification MIL-M-17194, type II, class 1 or class 2.
 - 3.3. **FASTENERS.**
 - 3.3.1. **Bolts and Nuts** shall be suitable for use intended.
 - 3.3.2. **Powder-Driven Fasteners** may be used only when approved in writing.
 - 3.3.3. **Screws.** Fed. Spec. FF-S-85, FF-S-92, and FF-S-111, as best suited for use intended.
 - 3.3.4. **Washers.** Fed. Spec. FF-W-84 for lock washers. Flat washers shall be suitable for use intended.
 - 3.4. **FLOOR PLATE, RAISED TREAD.** Fed. Spec. QQ-F-461, class 1, pattern to be selected by the Contracting Officer.
 - 3.5. **HARDWARE.** Unless otherwise specified, hardware provided as an integral part of miscellaneous metal shall conform to applicable ANSI Standard.
 - 3.6. **INSECT SCREEN.** Fed. Spec. RR-W-365, Type II, III, or VII, 18 by 16 mesh, or Fed. Spec. L-S-125, type II, bronze or aluminum color, 18 by 16 mesh.

4. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit the following:
 - 4.1. **CATEGORY II for approval.**
 - 4.1.1. Manufacturer's descriptive data as follows:
 - Access doors and access panels (Para. 9)
 - Handrails (Para. 24)

 - Shop and fabrication drawings as follows:
 - Support pipe
 - Rail supports
 - Hatch lids
 - Weather proof cabinets

5. **WORKMANSHIP.** Miscellaneous metalwork shall be formed to correct shapes and sizes with sharp lines, angles, true curves, and finish all in accordance with approved shop drawings and samples. Drilling and punching shall produce clean true lines and surfaces. All items shall be accurately set to established lines and elevations and securely fastened in place.
 - 5.1. **WELDING** shall be in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Connections to be exposed after installation shall be continuous welded. Exposed welds shall be ground smooth.
 - 5.2. **EXPOSED SURFACES** of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush.
 - 5.3. **JOINTS** where tight fits are required shall be milled to a close fit. Corner joints shall be coped or mitered, well formed, and in true alignment.
6. **QUALIFICATION OF WELDERS.** Welding to or on structural steel or miscellaneous items of structural steel such as lintels and ladders shall be performed by certified welders qualified in accordance with procedures covered in AWS D1.1 using procedures and materials and equipment of the type required for the work.
7. **ANCHORAGE** shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified shall include slotted inserts, expansion shields. Powder-driven fasteners shall not be used. Toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Slotted inserts shall be of types required to engage with the anchors and shall be approved.
8. **ACCESS DOORS AND ACCESS PANELS** shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 16-gage steel with welded joints and anchorage for securing into construction. Access door and panels shall be a minimum of not lighter than 14-gage steel. Access doors shall be 16 by 20 inches with stiffened edges and welded attachments and shall be hinged to frame and provided with a flush-face turn-screw-operated latch. [Access doors in fire rated walls and ceilings shall be of equivalent fire rating.] One access panel shall be provided and installed directly below each valve, flow indicator, damper, or air splitter that would otherwise not be accessible, and is located above the ceiling, except for suspended removable-panel-type ceilings. Manufacturer's descriptive catalog data shall be submitted. All components shall be galvanized.
9. **CORNER GUARDS AND SHIELDS** for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end-weld stud anchors. Corner guards for use with glazed or ceramic tile finish on walls shall be formed of 0.0625-inch thick corrosion-resisting steel, Fed. Spec. QQ-S-766, class 430 with polished or satin finish, shall extend 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and shall be anchored with adjustable anchors of 16-gage expanded metal.
10. **FLOOR GRATINGS AND FRAMES.** Floor gratings shall be designed to support a live load of 100 pounds per square foot for the spans indicated, and unless otherwise indicated shall conform to Fed. Spec. RR-G-661 or RR-G-1602. Edges of bar type gratings shall be banded with bars 1/8 inch less in depth than the bearing bars. Banding bars shall be flush with top of bearing bars. Frames of steel shapes and all-welded construction finished to match grating shall be provided as indicated. Frames shall be provided with welded-on anchors. Frames shall be anchored to structural members with bolts, toggle bolts, or expansion shields and bolts. Floor gratings and frames shall be galvanized.
11. **FLOOR PLATES** of patterned steel plate 1/4 inch thick shall be provided in dimensions and arrangements indicated.

12. **INDIVIDUAL-RUNG LADDER** shall conform to ANSI A14.3 and rungs shall be bent from 1-inch round solid steel rods, hot-dip zinc-coated after forming. Rungs shall be so shaped that the crossbar will be at least 3 inches below the horizontal plane of the side bars to prevent the foot from slipping off the rung. Individual bent steel rungs shall be spaced not over 12 inches on center and shall be anchored directly into concrete or masonry wall. Center of rung shall be 7 inches clear of wall. They shall be set in true alignment and projection to surface.
13. **MISCELLANEOUS PLATES AND SHAPES** lintels, sill angles, equipment mountings, and frames, shall be provided to complete the work. Miscellaneous plates and shapes shall conform to ASTM A 36.
14. **VAULT VENTS** shall be schedule 40 steel pipe, as indicated. Screen and fittings shall be type standard with the manufacturer.
15. **SHOP PAINTING.** Surfaces of ferrous metal, except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating. Bituminous primer, if used, shall conform to Fed. Spec. TT-V-51 or to Military Specification MIL-C-18480, but items to be finish painted shall be coated with other than a bituminous protective coating. Prior to shop painting surfaces shall be cleaned with solvents to remove grease and oil and with power wire-brushing or sandblasting to remove loose rust, loose mill scale, and other foreign substances. Surfaces of items to be embedded in concrete shall not be shop painted.

ZERO ACCIDENTS

SECTION 11303
GUIDE-MOUNTED SEWAGE LIFT STATIONS

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| 8. | MISCELLANEOUS | | |

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

1.1. **AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI) STANDARDS.**

- | | |
|------------------------|---|
| A21.51-1981
Erratum | Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined & Molds, for Water and Other Liquids |
| B16.1-1975 | Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 |

1.2. **AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS.**

- | | |
|----------------------|---|
| A 120-84 | Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses |
| A 153-82 | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| C 478-87 | Precast Reinforced Concrete Manhole Sections |
| C 890-78
(R 1985) | Minimum Structural Design Loading for Monolithic and Sectional Precast Concrete Water and Wastewater Structures |

1.3. **AMERICAN WATER WORKS ASSOCIATION (AWWA) STANDARD.**

- | | |
|----------|--|
| C 207-86 | Steel Pipe Flanges for Waterwork Service - Sizes 4 In. Through 144 In. |
|----------|--|

1.4. **ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA) STANDARDS.**

- | | |
|-------------|---|
| STD 9-1978 | Load Ratings and Fatigue Life for Ball Bearings |
| STD 11-1978 | Load Ratings and Fatigue Life for Roller Bearings |

1.5. **HYDRAULIC INSTITUTE (HI) PUBLICATION.**

- Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps (14th Edition, 1983)

1.6. **MANUFACTURER'S STANDARDIZATION SOCIETY OF VALVE AND FITTINGS INDUSTRY (MSS) PUBLICATION.**

SP-78 Cast Iron Plug Valves, Flanged, and Threaded Ends (1977)

1.7. **NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARD.**

MG-1-1978 Motors and Generators Incl Rev 1 thru 8

1.8. **NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATION.**

No. 70-1987 National Electrical Code

2. **GENERAL.** This section includes guide-mounted submersible sewage pumps, motors, duplex control panel alternator level switches, guide rails and supports, piping, valve chamber, pump chamber and accessories.

2.1. **STANDARD PRODUCTS.** Material and equipment to be provided shall be the standard catalog product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate material and equipment that have been in satisfactory use at least 2 years prior to bid opening.

2.2. **NAMEPLATES.** Each major component of equipment shall have the manufacturer's name, address, catalog or model number, rated power, and electrical requirements on a plate securely attached to the item of equipment.

2.3. **VERIFICATION OF DIMENSIONS.** The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

2.4. **FACTORY TESTS.** Pumps shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Where two or more identical pumps are specified, only one representative pump shall be tested. Certified test results shall be submitted to the Contracting Officer.

3. **SUBMITTALS.** In accordance with SECTION: SPECIAL CLAUSES, the Contractor shall submit for approval, items as listed in the following categories:

3.1. **CATEGORY I.**

Valves and Piping

Sewage Pumps

Motor Controls

Motors

Station Structure

Access Covers

Pump Characteristic Curves clearly shows the following information on the pump characteristic curves:

- Head-capacity curve
- Efficiency curve
- NPSH curve
- BHP curve
- Shut off head
- Maximum capacity at which pump can operate continuously with out cavitation
- Minimum capacity at which pump can operate continuously without overheating

Wiring Diagrams

3.2. CATEGORY II. Shall be submitted for information only.

Field Test Results
Spare parts data

3.2.1. For Approval.

Operating and Maintenance Instructions (Para. 13.2)

4. MATERIALS AND EQUIPMENT. The following materials and equipment shall conform to the respective publications and other requirements specified below.

4.1. CHECK VALVES.

4.1.1. Horizontal Swing Type Check Valves shall be installed in pump discharge lines and shall be suitable for handling domestic sewage. Valve shall permit free flow of sewage forward and provide a positive check against backflow. Body shall be iron with a removable cover for inspection and removal of the gate assembly. Gate, gate seat, gate studs and nuts shall be bronze or other suitable alloy.

4.1.2. Ball Check Valves, suitable for handling domestic sewage, are acceptable for installation in pump discharge lines 2 inches and smaller when recommended by the pump manufacturer. The valve shall be the non-slam type designed to permit free flow of sewage forward and a positive check against backflow. Valve shall have a cast-iron body with a renewable rubber seat. Ball shall be stainless steel unless otherwise indicated. All screws, nuts, and bolts shall be of stainless steel or other corrosion-resistant materials.

4.2. PLUG VALVES shall conform to MSS SP-78 and to the following:

Type - Nonlubricated

Pattern - Regular

Plug - Resilient facing resistant to hydrocarbons. Hycar or Buna N

Operator - Lever with position indicator

Exposed Bolts and Nuts - Zinc plated or stainless steel

4.3. PIPE.

4.3.1. Ductile Iron. ANSI A21.51, thickness class 53 with ANSI B16.1 class 125 flanges.

4.3.2. Steel Pipe. ASTM A 120, standard weight. Steel pipe shall not be installed in contact with earth.

4.3.3. Plastic Pipe. Plastic pipe shall not be installed within the pump chamber or the valve chamber. PVC pipe installed between the pump chamber and valve chamber shall conform to specification SECTION: FORCE MAINS; SEWER.

4.4. JOINTS.

4.4.1. Ductile Iron. Joints and fittings shall conform to ANSI B16.1, class 125.

4.4.2. Steel. Flanges shall conform to AWWA C207, Class D.

5. **ELECTRICAL WORK.** Motors, manual or automatic motor control equipment and protective or signal devices required for operation specified herein and any wiring required therefor, but not shown on the electrical plans, shall be provided under this section in accordance with SECTION: ELECTRICAL WORK, INTERIOR. All wiring and disconnect switches installed within the pump basin shall be suitable for class I, division I locations.
6. **SEWAGE PUMPS.**
 - 6.1. **GENERAL.**
 - 6.1.1. **Guide-Mounted Submersible Grinder Pumps.** Pumps shall be of the centrifugal type with an integrally built-in grinder unit and submersible motor. Each pump, when operating under conditions of the specified capacities and head, shall be as near the peak efficiency as practicable.
 - 6.2. **PUMP CHARACTERISTICS.** Pumps shall have the following operating characteristics:
 - 6.2.1. Furnish pumps which are two heavy duty grinder pumps, submersible units. Manufacturer's include but are not limited to Hydromatic, Vaughan Co. Inc., EBARA, and Gorman-Rupp.
 - 6.2.2. Pumps to handle domestic waste.
 - 6.2.3. Capacity Range 55 to 65 gpm.
 - 6.2.4. Total Head Range 50 to 60 ft.
 - 6.2.5. Power 200/230/460
 - 6.2.6. Minimum motor rating 5 H.P.
 - 6.2.7. Peak efficiency where practical to be selected
 - 6.2.8. Provide check valves and gate valves per pump manufacturer's recommendations.
 - 6.2.9. Provide manufacturer's mounting and installation details.
 - 6.2.10. 2" Discharge
 - 6.3. **CONTROLS.**
 - 6.3.1. **Controller.** The pump controller shall be mounted in NEMA 4X general-purpose stainless steel enclosures. The controls shall automatically alternate the lead pump between cycles. The controls shall be suitable for two sequences of pump operations, which can be alternated by manual setting, as follows:
 - 6.3.2. **Floats.** Sealed float-type mercury switches shall be provided to control sump levels and provide an alarm signal. Mercury switches shall be sealed in an inert synthetic casing suspended in the sump and held in place as detailed on the drawings. Three floats shall be provided for level control and one for alarm control.
 - 6.3.3. **High Level Alarm.** An alarm light and audible alarm shall be installed on the pump actuator in the control cabinet.
 - 6.3.4. **Operation.** On a rising liquid level, the lead pump shall be started when the liquid level reaches float number 2. When the liquid level reaches float number 3, the lag pump shall start and operate in conjunction with the lead pump. Both pumps shall operate until the liquid level falls to float number 1 (lowest). When the liquid level reaches float number 4, the alarm light and bell shall be actuated, indicating a high liquid level. Float switch

number 1 will stop pump operation. A mechanical or electrical automatic alternator shall be provided to transpose the starting sequence of the lead pump.

6.3.5. Runtime Meter. Runtime meter shall be installed for each pump.

6.3.6. Pump Failure Alarm. A logic circuit connected to the activator shall activate an alarm light and audible alarm. The audible alarm shall be equipped with a silencing switch with automatic reset. This alarm shall be activated when the lead pump fails to start when called for.

7. PUMP CONSTRUCTION.

7.1. POWER CABLE.

7.1.1. The power cable shall comply with NFPA No. 70, Type SO, and shall be of standard construction for submersible pump applications sized according to NEC standards.

7.1.2. The power cable shall enter the pump through a heavy-duty entry assembly provided with an internal grommet assembly to prevent leakage. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board which shall isolate the motor interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems are not acceptable.

7.1.3. The power and control cables shall be run continuously between controller and pumps.

7.2. SEALING FLANGE. Each pump shall be equipped with a sliding guide bracket which will mate to the pump discharge elbow when the pump is lowered into position. Connection shall be made in such a manner to provide a leakless seal without the use of bolts and nuts and without personnel entering the pump pit.

7.3. GRINDER ASSEMBLY. The grinder assembly shall consist of a hardened stainless steel renewable cutter ring and cutter impeller. The assembly shall be designed to shear and reduce all materials normally found in domestic sewage such as wood, plastic, and rags into a fine slurry. The slurry shall be capable of passing through 2-inch diameter piping system including check and valves.

8. MISCELLANEOUS.

8.1. RAIL-MOUNTED SYSTEMS.

8.1.1. Rail Mounted System for Grinder Pumps. Rail mounted installation systems shall consist of galvanized guide rails, a sliding bracket and a sealing flange. Guide rails shall be of the size and type standard with the manufacturer and shall not support any portion of the weight of the pump. Guide rails shall be anchored at the top and bottom of the basin with intermediate supports provided if wet well depth exceeds 12 feet. The sliding guide bracket shall be an integral part of the pump unit. The sealing flange shall be permanently installed in the wet well along with the discharge piping. The check valve shall be located between the pump discharge and the sealing flange such that the check valve is removed with the grinder pump as an assembly. The pump shall be automatically connected to the sealing flange when lowered into place and shall be easily removed for inspection and service without entering the pump chamber.

8.1.2. Lifting Chain. Lifting chain to raise and lower the pump through the limits indicated shall be provided. The chain shall be galvanized and shall be capable of supporting the pump.

8.2. PUMP AND AIR RELEASE CHAMBERS.

8.2.1. Concrete. Pump chamber shall be constructed of precast manhole sections conforming to ASTM C 478 and SECTION: PRECAST PRESTRESSED CONCRETE UNITS. Air release chambers may be of precast concrete manhole sections conforming to ASTM C 478; precast concrete designed in accordance with ASTM C 890 and SECTION: PRECAST PRESTRESSED CONCRETE UNITS, or poured-in-place concrete as detailed on the drawings. The top and bottom slabs shall be constructed as detailed on the drawings. Pour-in-place concrete shall conform to the SECTION: CONCRETE.

8.3. ACCESS FRAMES AND DOORS. Access doors and curb frames shall be provided complete with interior snap lock, removable key wrench, cast steel hinges, and locking bar. Doors shall lock in the open 90 Degrees position. Doors shall be of aluminum plate construction with non-slip diamond pattern rated for a live load of 150 pounds per square foot. Bituminous coating shall be applied to the exterior of the frame.

8.4. LABELS. All switches, lights, horns, controls, etc., shall be clearly identified with permanent labels or tags. The labels shall be plastic or metal and shall be permanently attached.

9. MISCELLANEOUS METAL. Bolts, nuts, anchors, washers, and all other types of supports necessary for the installation of the equipment shall be furnished and shall be of steel galvanized according to ASTM A 153.

10. SPECIAL TOOLS necessary for the proper operation and maintenance of the equipment, including one pressure gun for each type of grease required, shall be furnished in a hardwood or metal container.

11. ACCEPTANCE TESTS. The Contractor shall furnish the manufacturer's report of pump capacity determined by shop tests and make such tests as may be necessary to verify the pump capacity. Tests shall assure that all equipment, including the pump, have been installed in accordance with the specifications. Tests shall assume that pumps, controls, and fittings, as installed, are operating as specified.

12. PUMP CHARACTERISTIC CURVES, properly identified and prepared by the pump manufacturer showing capacities, heads, efficiencies, and brake horsepower throughout the entire range of the pump, shall be furnished.

13. OPERATING AND MAINTENANCE INSTRUCTIONS AND SPARE-PARTS DATA.

13.1. SPARE-PARTS DATA. The Contractor shall furnish spare-parts data for each different item of materials and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

13.2. OPERATING AND MAINTENANCE INSTRUCTIONS.

13.2.1. Operating instructions outlining the step-by-step procedures required for system start-up and operation shall be furnished. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.

13.2.2. Maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs shall be furnished. The instructions shall include simplified diagrams for the system as installed.

- 13.2.3. Contractor shall conduct a training course for operating staff as designated by the Contracting Officer. The training period shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the Operating and Maintenance Instructions.
- 13.2.4. Framed instructions, under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting. The framed instructions shall be posted before acceptance testing of the systems.

ZERO ACCIDENTS

SECTION 16415
ELECTRICAL WORK, INTERIOR

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| 7. | WIRING METHODS | 18. | MOTOR-DISCONNECT MEANS |
| 8. | BOXES AND SUPPORTS | 19. | EQUIPMENT CONNECTIONS |
| 9. | DEVICE PLATES | 20. | PAINTING AND FINISHING |
| 10. | RECEPTACLES | 21. | TESTS |
| 11. | WALL SWITCHES | 22. | SPARE PARTS |

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

1.1. **FEDERAL SPECIFICATIONS (Fed. Spec.).**

- | | |
|-----------------------------------|--|
| J-C-30A
& Am-1 | Cable and Wire, Electrical (Power, Fixed Installation) |
| L-C-530C | Coating, Pipe, Thermoplastic Resin |
| L-P-387A
& Am-1
& Int. Am-2 | Plastic Sheet, Laminated, Thermosetting (For Designation Plates) |
| L-P-1035A | Plastic Molding Material, Vinyl Chloride Polymer and Vinyl Chloride-Vinyl Acetate Copolymer, Rigid |
| L-T-001512A
(GSA-FSS) | Tape, Pressure-Sensitive Adhesive, Pipe Wrapping |
| W-C-586C | Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal |
| W-C-596F/
& Sup. 1
W-C-1094 | Connector, Electrical, Power, General Specification for Conduit and Conduit Fittings, Plastic, Rigid |
| W-F-406C | Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible |
| W-F-408C
Am-1 | Fittings for Conduit, Metal, Rigid (Thick-Wall and Thin-Wall (EMT) & Type) |
| W-J-800E | Junction Box; Extension, Junction Box; Cover, Junction Box (Steel, Cadmium, or Zinc-Coated) |
| W-L-101H
Suppl. 1 | Lamp, Incandescent, (Electric, Large Tungsten-Filament) (General & Specification) |
| W-P-455a | Plate, Wall Electrical |

& Am-6

W-S-610D Splice Conductor

W-S-865c Switch, Box, (Enclosed), Surface-Mounted
& Int Am-2

CC-M-1807A Motors, Alternating Current, Fractional and Integral Horsepower (500
HP and Smaller)

HH-I-553C Insulation Tape, Electrical, (Rubber, Natural and Synthetic)
& Am-1

HH-I-595C Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

WW-C-00540c Conduit, Metal, Rigid: and Coupling, Elbow, and Nipple, Electrical &
Int. Am-1

WW-C-566C Conduit, Aluminum Conduit, Metal, Flexible

1.2. AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI) STANDARDS.

C2-1987 National Electrical Safety Code

C12.1-1982 Code for Electricity Metering

C12.4-1984 Mechanical Demand Registers

C39.1-1981 Electrical Analog Indicating Instruments

C57.13-1978 Requirements for Instrument Transformers

C97.1-1972 Low-Voltage Cartridge Fuses 600 Volts or Less

1.3. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATION.

D 69-85 Friction Tape

1.4. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) STANDARDS.

No. 142-1982 Recommended Practice for Grounding of Industrial and Commercial Power
Systems

1.5. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS.

ICS 1-1978 General Standards for Industrial Control and Systems
Incl. Rev. 1
thru 4 (R 1983)

ICS 2-1983 Industrial Control Devices, Controllers and Assemblies
Incl. Rev. 1
thru 3

ICS 3-1983 Industrial Systems

ICS 4-1983 Terminal Blocks for Industrial Control Equipment and Systems

- ICS 6-1983 Enclosures for Industrial Controls and Systems
Incl. Rev. 1
(R 1983)
- MG 1-1987 Motors and Generators
- RN 1-1986 Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical
Metallic Tubing
- TC 2-1983 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
- WD 1-1983 See Fed. Spec. W-C-596

1.6. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATIONS.

- No. 70-1987 National Electrical Code ("NEC")
& Int Am 70-87-1
& Int Am 70-87-2
& Int Am 70-87-3

1.7. UNDERWRITERS LABORATORIES, INC. (UL) PUBLICATIONS.

Building Materials Directory (Jan 1988 with Quarterly Supplements)

- UL 5 Surface Metal Raceways and Fittings (May 28, 1985, 10th Ed.)
- UL 20 General-Use Snap Switches (Jun 12, 1986, 10th Ed.; Rev thru Sep 23, 1986)
- UL 50 Cabinets and Boxes (Apr 25, 1980, 8th Ed.; Rev. thru Feb 21, 1982)
- UL 57 Electric Lighting Fixtures (Aug 30, 1972, 12th Ed.; Errata Sep 23, 1975; Rev.
thru Jul 22, 1982)
- UL 198C High-Interrupting-Capacity Fuses, Current-Limiting Types (Jul 21, 1986, 5th Ed.;
Rev. thru Mar 26, 1987, Errata Sep 3, 1987)
- UL 198H Class T Fuses (Jul 13, 1988, 4th Ed.)
- UL 360 Liquid-Tight Flexible Steel Conduit (Aug 18, 1986, 3rd Ed.)
- UL 467 Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev. April 30, 1985)
- UL 508 Industrial Control Equipment (Aug 17, 1984, 14th Ed.; Rev. thru Dec 5, 1986)
- UL 514A Metallic Outlet Boxes (Dec 1, 1983, 7th Ed.; Rev. thru Oct 27, 1987)
- UL 674 Electric Motors and Generators for Use in Hazardous Locations, Class I, Groups
C and D, Class II, Groups E, F, G (1st Ed., Rev thru Nov 21, 1984)
- UL 797 Electrical Metallic Tubing (Oct 10, 1983, 5th. Edition)
- UL 817 Cord Sets and Power-Supply Cords (Dec 22, 1986, 9th Ed.; Rev thru Sep 7,
1987)
- UL 857 Busways and Associated Fittings (Jan 11, 1982, 9th Ed.; Rev. thru Dec 28, 1987)
- UL 869 Service Equipment (May 28, 1984, 6th Ed.; Rev. thru Jun 8, 1987)
- UL 1242 Intermediate Metal Conduit (Oct 10, 1983, 1st Ed.; Rev April 10, 1986)

2. GENERAL

- 2.1. **RULES.** Unless otherwise specified, the installation shall conform to the requirements of the National Electrical Code, NFPA No. 70. Damp locations, in addition to those defined in the NEC, shall include all exposed surfaces of all perimeter single wythe masonry or concrete walls above or below grade. Wet locations, in addition to those defined in the NEC, shall include all sump locations.
- 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 will be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit work tasks when work stations are fixed by design and shown on contract drawings. 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 departures and reasons therefor shall be submitted as soon as practicable for written approval of the Contracting Officer. See SECTION: SPECIAL CLAUSES (01100), paragraph 4.5: EQUIPMENT ROOM DRAWINGS.
- 2.3. **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.
- 2.4. **IDENTIFICATION NAMEPLATES.** Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Unless otherwise specified, all identification nameplates shall be made of laminated plastic in accordance with Fed. Spec. L-P-387 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws or approved nonadhesive metal fasteners. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The following equipment, as a minimum, shall be provided with identification nameplates:
- | | |
|-------------------------------|--|
| Minimum 1/4-Inch High Letters | Minimum 1/8-Inch High Letters |
| Control Power Transformers | Pumps # 1 and #2 |
| Starters | Instrument Transformers |
| Safety Switches | Control Devices (Relays, Contactors, Etc.) |
- 2.5. **INSULATING FLUIDS.** Fluids containing tetrachloroethylene (parchloroethylene) or polychlorinated biphenyls (PCBs) are not acceptable as an insulating medium in transformers, ballasts, capacitors, or other equipment.
- 2.6. **APPLICATION OF THIS SECTION.** All electrical equipment and materials must conform to the product requirements of this section (ELECTRICAL WORK, INTERIOR), and must be installed in the manner prescribed in this section to the extent not covered under other electrical sections of these specifications. The provisions of ELECTRICAL WORK, INTERIOR shall also apply to electrical supporting items required by equipment furnished under nonelectrical sections and to electrical subsystems and components of equipment specified as package assemblies in nonelectrical sections, unless specifically excluded or modified in those sections. For additional requirements pertaining to connection of various types of equipment, see paragraph EQUIPMENT CONNECTIONS later in this section.

3. SUBMITTALS.

3.1. **SUBMITTAL PROCEDURES.** Data shall be submitted in accordance with the overall requirements detailed in the SECTION: SPECIAL CLAUSES and the specific requirements of this section. Documents shall consist of a complete list of equipment and materials, manufacturer's descriptive and technical literature, brochures, catalog cuts, performance data, diagrams, and other material as appropriate. As a minimum the following must be submitted:

3.1.1. Category I.

Drawings and data on the following components: (Para. 5.27, 13)

Service Equipment

Motor Control (Para. 5.22, 20, 21, 27.1)

Metering Equipment

Conductor Terminators and Connectors Rated 75 degrees C. (#12 through #1)

Busway Systems (Para. 5.2, 7.4)

Operation and Maintenance Manuals (Para. 3.4)

3.1.2. Category II (For Information).

Drawings and data on the following components:

List of Equipment and Materials (Para. 3.3)

3.2. **PROOF OF COMPLIANCE.** Where materials or equipment are specified to conform to the standards or publications, and requirements of ANSI, ASTM, AWWA, IEEE, NEMA, NFPA, or UL, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements.

3.2.1. **Underwriters Laboratories, Inc. (UL) Publications.** 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, the Contractor shall submit 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. 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.

3.2.2. **Non-Underwriters Laboratories, Inc. (UL) Publications.** For equipment and materials specified to conform to Federal Specifications, or any of the above commercial standards, a manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications or standards publications will be acceptable evidence of such compliance.

3.3. **LIST OF EQUIPMENT AND MATERIALS.** A complete itemized listing of equipment and materials proposed for incorporation into the work shall be submitted. Each such itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

3.4. **INSTRUCTION MANUALS.** Instruction manuals shall be furnished following the completion of factory 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 and all documents previously submitted and

approved. Manuals shall also include data outlining step-by-step 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 and their basic operating features shall also be included. Documents shall be bound in a suitable binder adequately 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. The following equipment shall be covered: pump controls, pump motors.

3.5. MANUFACTURER'S CERTIFICATIONS.

3.5.1. Certificates of Compliance. Certificates shall be prepared by the manufacturer when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

4. **WORKMANSHIP.** Materials and equipment shall be installed in accordance with recommendations of the manufacturer to conform with the contract documents. The installation shall be accomplished by workmen skilled in this type of work.

5. **MATERIALS AND EQUIPMENT.** Materials and equipment shall conform to the respective publications and other requirements specified below. Other materials and equipment shall be as specified elsewhere herein and as shown on the drawings.

5.1. **CABLES.** Cables shall conform to Fed. Spec. J-C-30 and shall be of annealed copper, aluminum conductors are not permitted. Design is based on copper conductors. Cables may be single-conductor type, unless otherwise indicated.

5.1.1. **Metallic Armored Cable.** Type ACHH or ACT

5.1.2. **Nonmetallic Sheathed Cables.** Type NM or NMC, with ground conductor.

5.1.3. **Service Entrance Cable.** Type SE.

5.1.4. **Grounding Cables.** Grounding cables shall be bare or shall have green low-voltage insulation.

5.1.5. **Cord Sets and Power-Supply Cords.** UL 817.

5.2. CONDUIT.

5.2.1. **Flexible Steel Conduit.** Fed. Spec. WW-C-566 and UL 360.

5.2.2. **Rigid Metal Conduit.** UL 6.

5.2.3. **Rigid Aluminum.** Fed. Spec. WW-C-540.

5.2.4. **Rigid Plastic.** Fed. Spec. W-C-1094 and NEMA TC 2.

5.2.5. **PVC Coated Rigid Steel Conduit.** NEMA RN 1.

5.2.6. **Intermediate Metal Conduit (IMC).** UL 1242, Type I.

5.2.7. **Conduit Coatings.**

- 5.2.7.1. **Plastic Resin System.** Fed. Spec. L-C-530, Type I; or Fed. Spec. L-P-1035, composition, type, class, and grade suitable for the purpose, thickness as required for the Type I system of Fed. Spec. L-C-530; or NEMA RN 1, Type A-40.
- 5.2.7.2. **Epoxy System.** Fed. Spec. L-C-530, Type II.
- 5.2.7.3. **Coal-Tar System.** AWWA C 203. The thickness of the dry coating system shall be not less than 1/16 inch at any point.
- 5.2.7.4. **Pipe Wrapping Plastic Tape.** Fed. Spec. L-T-1512, type I.
- 5.3. **CONNECTORS, WIRE PRESSURE.** Fed. Spec. W-S-610.
- 5.4. **DEVICE PLATES.** Fed. Spec. W-P-455.
- 5.5. **FITTINGS, CABLE AND CONDUIT.** Fed. Spec. W-F-406 and W-F-408.
- 5.6. **FUSES.**
 - 5.6.1. **Cartridge Fuses.** Nonrenewable, dual element, time lag type, ANSI C97 1, Class H.
 - 5.6.2. **Current Limiting Fuses.** Fed. Spec. W-F-1814 (Class G, J, K1, K5, K9, RK1, RK5, L), UL 198C (Class G, CC, J, L), UL 198E (Class RK1, RK5) and UL 198H (Class T).
- 5.7. **INSTRUMENTS-RELAYS, ELECTRICAL INDICATING.** NEMA II 2.
- 5.8. **LAMPS.**
 - 5.8.1. **Incandescent Lamps, Large.** Fed Spec W-L-101.
- 5.9. **METERING EQUIPMENT.**
 - 5.9.1. **Current and Potential Transformers.** ANSI C12.11 and C57.13.
 - 5.9.2. **Demand Registers.** ANSI C12.4.
- 5.10. **MOTORS, AC, FRACTIONAL AND INTEGRAL HORSEPOWER (500 HP AND SMALLER).** Fed. Spec. CC-M-1807.
- 5.11. **MOTOR CONTROLS.** NEMA ICS 1, ICS 2, ICS 3, ICS 4, and ICS 6, and UL 508 and 845.
- 5.12. **OUTLETS.**
 - 5.12.1. **Conduit, Cast-Metal.** Fed. Spec. W-C-586.
 - 5.12.2. **Floor.** UL 514A.
- 5.13. **OUTLET BOXES.**
 - 5.13.1. **Sheet-Steel Outlet Boxes.** Fed. Spec. W-J-800.
 - 5.13.2. **Switch, Box; (Enclosed), Surface-Mounted.** UL 98.
- 5.14. **RECEPTACLES.**
 - 5.14.1. **General Grade Receptacles.** Fed. Spec. W-C-596.

5.14.2. **Standard Grade Receptacles.** UL 498.

5.15. **SERVICE EQUIPMENT.** UL 869, general purpose enclosure unless otherwise specified. Size and voltage as required by the drawings.

5.16. **SPLICE, CONDUCTOR.** Fed. Spec. W-S-610.

5.17. **SWITCHES.**

5.17.1. **Enclosed Safety Switches.** Fed. Spec. W-S-865, Type HD with general purpose enclosures unless otherwise specified. Size and voltage as required by the drawings.

5.17.2. **Snap Switches.** UL 20.

5.18. **TAPES.**

5.18.1. **Friction Tape.** ASTM D 69.

5.18.2. **Plastic Tape.** Fed. Spec. HH-I-595.

5.18.3. **Rubber Tape.** Fed. Spec. HH-I-553.

5.19. **TRANSFORMERS.**

5.19.1. **Instrument Transformers.** ANSI C12.11 for 0.6 kV insulation class with a primary rating suitable for the rated voltage and current of the secondary main bus of the transformer station.

5.20. **TUBING, ELECTRICAL, ZINC-COATED STEEL (EMT).** UL 797.

5.21. **GROUNDING AND BONDING.** UL 467.

5.21.1. **Ground Rods.** Ground rods shall be of copper-clad steel. If an exact size is not shown in the plans the contractor may select a size, but it must not be less than 3/4 inch in diameter, 8 feet long, driven full length into the earth.

5.21.2. **Ground Bus.** The ground bus shall be bare copper conductor or flat copper bar in one piece, if practicable. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

6. **GROUNDING.**

6.1. **SERVICE GROUNDING.** The service ground connection shall be made to the neutral conductor of the wiring system at the main service equipment and shall be extended to the grounding electrode system. The grounding electrode system shall be as stated in the NEC with the additional requirement that at least one driven ground rod shall be provided in addition to other available electrodes and a bonding connection shall not be provided to the exterior portion of metallic underground water pipe (even if an isolating fitting is not presently installed). Provide a minimum of two driven rods if no other NEC electrodes are available. A separate grounding connection shall be made from the neutral conductor of separately derived systems to the nearest available structural steel or alternate electrode to the main service ground electrodes as indicated on the plans.

6.2. **EQUIPMENT GROUNDING.** Except where specifically indicated otherwise, all exposed noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, ground bus, shall be grounded. In addition to the metallic raceway system used as a grounding conductor, a separate green wire grounding conductor shall be provided for receptacle circuits. The receptacle shall either be bonded to the outlet box or shall be a self-grounding type

receptacle. The additional green wire shall be connected to the receptacle ground terminal or the bonding jumper and carried through all feeder and service ducts to the service ground point or separately derived source ground.

- 6.3. **CONTINUITY.** The electrical continuity of metallic raceway systems and cable armor shall be assured by removing any portions of nonconducting coatings which might interrupt or diminish such continuity. Grounding continuity between recessed outlet boxes and the grounding circuits of receptacles shall be established by means of a bonding jumper between the outlet box and the receptacle grounding terminal or by the use of a selfgrounding receptacle. Where surface-mounted boxes and conventional receptacles are used, the retainer washers on the receptacle mounting screws shall be removed to permit metal-to-metal contact between the yoke and the outlet box.
- 6.4. **GROUND RODS.** The maximum resistance of a driven ground, measured in accordance with IEEE No. 142, shall not exceed 25 ohms under normally dry conditions.
- 6.5. **GROUND BUS.** Ground bus shall be provided in the electrical equipment room as indicated. If not otherwise identified, install one copper bar, 1/8 x 1 x 12 inch minimum near service equipment. Noncurrent-carrying metal parts of electrical equipment shall be effectively grounded by bonding to the bus. The ground bus shall be bonded to both the entrance ground, and to a local ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. The external grounding connections described above are supplementary provisions required in addition to conventional equipment grounding via an electrically continuous raceway system or a separate equipment grounding conductor installed within the raceway system adjacent to corresponding phase conductors.

7. WIRING METHODS.

- 7.1. **GENERAL REQUIREMENTS.** Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, electrical metallic tubing, or Type I intermediate metal conduit. Plastic conduit is not acceptable for interior wiring.
- 7.2. **CONDUIT AND TUBING SYSTEMS.** Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on the use of TW insulation for conductors smaller than No. 8 AWG, THW insulation for conductors No. 8 AWG and larger, except where otherwise indicated. Minimum size of raceways shall be 1/2 inch. Electrical metallic tubing may be installed only within buildings. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations. IMC Type I may be used as an option for rigid steel conduit in areas as permitted by NFPA No. 70, except as hereinafter specified. 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 where possible within finished walls, ceilings, and floors other than slabs-on-grade. Raceways crossing structural expansion 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. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by NFPA No. 70. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered.
 - 7.2.1. **Installing Conductors and Conduit Below Slab-on-Grade or in the Ground.** All electrical wiring below slab-on-grade shall be protected by a conduit system. No conduit system shall be installed horizontally within concrete slabs-on-grade. For slab-on-grade construction, horizontal runs of rigid plastic or rigid steel or IMC shall be installed below the floor slab. 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 be field-wrapped with 0.010-inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied plastic resin, epoxy,

or coal-tar coating system. Zinc coating may be omitted from rigid steel conduit, or from IMC which has a factory-applied epoxy system.

7.2.2. Supports. Raceways shall be securely and rigidly fastened in place at intervals of not more than 10 feet with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps with retainers, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging. Fastenings 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. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by NFPA No. 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. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by NFPA No. 70. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered.

7.2.3. Pull Wires. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200-pound tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

7.3. CABLE SYSTEMS. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of end surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing.

7.4. CONDUCTORS. Conductors in raceways and cable shall be of copper. Wire connectors of insulating material or solderless pressure connectors properly taped shall be utilized for all splices where possible. Soldered mechanical joints insulated with tape shall be kept to a minimum. Circuits that have been specifically required to be suitable for use at 90 degrees C. must be supplied with terminating components approved for use at that temperature. The temperature rating must be marked on all terminals sized #12 through #1 AWG and intended for use at 75 degrees C. all terminals intended for use at 90 degrees C. Connection of oversize conductors to equipment or devices having smaller terminals shall be made with suitable connectors or adapters which will accommodate the entire conductor cross section (trimming "excess" stranding is not acceptable).

- 7.4.1. **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 center of load, shall be No. 10 AWG. Conductors for control, signaling, or power limited applications shall be not less than No. 14 AWG.
- 7.4.2. **Insulation.** Conductor insulation shall be suitable for the application and shall have a temperature rating of not less than 75 degrees C.
- 7.4.3. **Phase Identification.** Conductor identification of each phase shall be by color-coded insulation. The color of the insulation of the ungrounded conductors of different voltage systems shall be as follows:

208Y/120 volt, 3-phase: red, black, and blue

In multiphase circuits, the above colors, left to right, shall be connected to A, B, and C phases, respectively. Phases must be identified by tags or labels wherever the above format has not been followed. Control 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 by the Contracting Officer. Control conductors shall not repeat the power circuit color coding unless control wiring is clearly distinguishable by application or by added identification. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable. Where insulation of the required color is not available, electrical tape of the required color shall be half-lapped for the entire length within the indicated enclosures.

- 7.5. **WIREWAYS** shall be of the size indicated on the drawings and shall be provided with a screw-on cover. Wireways shall be supported at intervals not exceeding 5 feet.
8. **BOXES AND SUPPORTS.** Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Each box must have the volume required by NFPA No. 70 for the number of conductors enclosed in the box.
- 8.1. **APPLICATION REQUIREMENTS.** Boxes for metallic raceways shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, when located in hazardous areas, and when installed exposed up to 7 feet above interior floors and walkways. 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-sheathed or metallic-armored cable system. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Apply a flush mounting adapter (Cousse Hinds FS031, FS031PM or equal), if the box is not installed in a poured concrete wall. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The edge of boxes shall flush with the finished surfaces in gypsum, plasterboard installation. The bottom of boxes installed in masonry-block walls for concealed wiring shall be flush with the top of a block to minimize cutting of blocks and boxes shall be located horizontally to avoid cutting webs of block. Indicated elevations are approximate. Unless otherwise indicated, boxes for wall switches and receptacles shall be mounted per attached Drawing 40-15-01, Sheet 2.
- 8.2. **SUPPORTING PROVISIONS.** 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 screws 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. In partitions of light steel construction, bar hangers (with 1-inch long threaded studs) or metal stud "C" brackets shall be used to secure boxes to the building structure. Bar

hangers are to be mounted between the vertical metal wall studs, metal stud "C" brackets are to be snapped on and tab locked to metal wall studs. When "C" brackets are used, additional box support shall be placed on the side of the box opposite the brackets. In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box. 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.

- 8.3. **BOXES FOR USE WITH RACEWAY SYSTEMS.** Boxes shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture and telephone outlets shall be not less than 4 inches square except that 4- by 2-inch boxes may be used where only one raceway enters the outlet. In applications where cast boxes are required, boxes may be 4 x 2-1/4 inch by 2-1/2 inch depth minimum. (All dimensions are internal.) Cast metal boxes with 3/32-inch wall thickness are acceptable.
 - 8.4. **PULL BOXES.** Pull boxes of not less than the minimum size required by NFPA No. 70 shall be constructed of galvanized sheet steel, except where cast-metal boxes are required in locations specified above. Boxes shall be furnished with screw-fastened covers. 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.
 - 8.5. **CONDUIT STUB-UPS.** Conduits stubbed up through concrete floors for connections to freestanding equipment shall be provided with a short elbow and an adjustable top or coupling threaded inside for plugs, set 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. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made to suit the devices installed.
9. **DEVICE PLATES.** One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be impact-resistant plastic and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed. Device plates for telephone and intercommunication outlets shall have a 3/8-inch bushed opening in center.
10. **RECEPTACLES.** (See paragraph titled **GROUNDING**). Device shall be straight blade type unless twist lock versions have been designated on the plans.
- 10.1. **STANDARD RECEPTACLES.** Single and duplex receptacle for the ordinary application shall be 125-volt, two-pole, three-wire grounding type with polarized parallel slots. Devices rated 15 amperes (NEMA 5-15) may be furnished for all devices not specifically required to be 20 ampere (NEMA 5-20). Bodies shall be of ivory phenolic compound 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 switched receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application.

- 10.2. RECEPTACLES, 20-AMPERE, 120-VOLT (NEMA 6-20).** Receptacles, single, 20-ampere, 120-volt, shall be molded plastic, two-pole, three-wire, grounding type.
- 11. WALL SWITCHES.** Switches shall be of the totally enclosed tumbler type with bodies of phenolic compound. Handles shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than two switches shall be installed in a single-gang position. Switches shall be rated 20-ampere 120-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red.
- 12. SERVICE EQUIPMENT.**
- 12.1. DISCONNECTING PROVISIONS.** Service-disconnecting means shall be of the fusible safety switch type as indicated with external handle for manual operation. The disconnect device shall be housed in an individual sheet metal enclosure with hinged cover or door, and shall be suitable for surface mounting unless indicated otherwise.
- 13. FUSES.** A complete set of fuses for switches, panels, bus plugs, switchgear, and control centers shall be furnished as required. Time-current-tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be coordinated for the proper operation. Fuses shall have a voltage rating not less than the circuit voltage. If the type is not otherwise identified, the fuse sizes shown on the plans assume the use of Class RK5 dual element fuses for motor, transformer, and ballast type lighting loads and Class RK1 single element fuses for general loads, Class RK1 dual element fuses for mixed loads. Class H fuses may be used only where specifically designated. Cartridge fuses shall be used for circuits rated in excess of 30 amperes, 125 volts, except where indicated otherwise on the plans.
- 14. UNDERGROUND-SERVICE CONDUITS.** Conduits for underground electric-service cable shall be installed as indicated. Except where otherwise indicated, conduits shall terminate a minimum of 5 feet beyond the building wall and 2 feet below finished grade, with the outside ends bushed and plugged or capped.
- 15. AERIAL SERVICE.** Aerial-service entrance conductors shall be installed in rigid conduit of sizes as indicated, from service equipment to a point on the exterior of the building as directed by the Contracting Officer. Four feet of slack conductor shall be extended from service-entrance fitting to permit connection to service drop. Conduit shall be concealed within the walls of the building where possible, and shall terminate on the exterior with an appropriate weatherproof fitting.
- 16. MOTORS.** (Also see paragraph: EQUIPMENT CONNECTIONS.) Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degrees C. ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified elsewhere. Each motor controller and/or disconnect switch hereinafter specified shall be clearly labeled on the cover to indicate the equipment controlled. The labeling shall be consistent with subparagraph 2.5: IDENTIFICATION NAMEPLATES of this section.
- 16.1. SIZE SELECTION.** Motors shall be of sufficient size for the duty to be performed and shall not exceed the full-load rating when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. In addition, all motors installed above a mean sea level altitude of 3,300 feet shall be derated 1 percent for each 330 feet or fraction thereof above 3,300 feet. Derating due to altitude will not be required on hermetically sealed motors and integrally mounted motors (integrally mounted motors are those in equipment

where the motor housing and driven equipment housing are integral and on the same common shaft). Motor service factor cannot be considered in selection of horsepower size or altitude derating; the standard service factor must be available undiminished in the field installation. The horsepower ratings indicated on electrical plans are for guidance only and do not limit the equipment size. When electrically driven equipment furnished under other sections of these specifications materially differs from the contemplated design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, starters, controls, and branch-circuit protection to accommodate the equipment actually installed.

17. **MOTOR CONTROL.** (Also see paragraph: EQUIPMENT CONNECTIONS) Each motor or group of motors requiring a single control shall be provided with a suitable controller and devices that will perform the functions as specified for the respective motors. In the absence of specific instructions in other sections of the specifications or on the plans, a controller may be furnished with the motor or the equipment it controls, or it may be separately furnished and mounted on the nearest clear wall space at the Contractor's option. Specific control features shall be provided as indicated on the plans and elsewhere in the specifications. All control shall be 120 volts or less unless otherwise indicated. Auxiliary contacts shall be included as required to accommodate the specific control requirements called for elsewhere in the specifications or on the plans. Unless indicated otherwise, in each magnetic starter provide one spare normally open and one normally closed auxiliary contact.
- 17.1. **CONTROLLER APPLICATION.** Single- or double-pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float, or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic control device actuating the pilot-control circuit. When the automatic control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. When combination manual- and automatic-control is specified and the automatic-control device operates the motor directly, a switch of the double-throw, three-position tumbler, or rotary type shall be provided for the manual control. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagrams approved by the Contracting Officer unless such diagram is included on the drawings.
- 17.2. **OVERLOAD PROTECTION.** Each motor of 1/8 horsepower or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. In magnetic starters, the overload contacts shall be connected on the grounded side (i.e., downstream) of the starter operating coil per NEMA ICS 2.
18. **MOTOR-DISCONNECT MEANS.** (Also see paragraph: EQUIPMENT CONNECTIONS.) Each motor shall be provided with a disconnecting means when required by NFPA No. 70 even though not indicated. Each disconnect shall be located in sight from the motor controller location. The disconnecting means shall be capable of being locked in the open position when the motor is not in sight of the switch and controller unless another disconnecting means is located at the motor. For single-phase motors, a single- or double-pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors. Enclosed switches shall be horsepower-rated in conformance with Table III of Fed. Spec. W-S-865. Switches shall disconnect all ungrounded conductors.

19. **EQUIPMENT CONNECTIONS.** (Also see subparagraph: APPLICATION OF THIS SECTION). All 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 raceways 6 feet or less in length shall be provided to all electrical equipment subject to vibration or movement and for all motors. Liquid-tight raceways shall be used in damp or wet locations.
- 19.1. **MOTORS AND MOTOR CONTROL.** Motors will be furnished under other sections of the specifications unless otherwise indicated. Control equipment shall be furnished and connected under this section of the specifications unless shown or specified otherwise. Except as otherwise specifically noted, automatic-control wiring, signaling, and regulatory and safety control devices are not included in this section of the specifications, but shall be furnished and installed under other sections of the specifications. Control wiring not shown on the drawings shall be furnished under the other sections of the specifications. Protective devices (overloads, fuses, limit switches, etc.) which act on the motor feeder directly shall be furnished under this section.
- 19.2. **INSTALLATION OF GOVERNMENT-FURNISHED EQUIPMENT.** Wiring shall be extended to the equipment, and proper connections made thereto.
- 19.3. **DISCONNECTING PROVISIONS.** When a process control, temperature control, or other auxiliary panel is furnished without an interrupting device, an external switch that will disconnect all ungrounded conductors shall be installed.
20. **PAINTING AND FINISHING.** Field-applied paint on exposed surfaces shall be provided under SECTION: PAINTING, GENERAL.
21. **TESTS.** After the interior-wiring-system installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power. The Contractor shall submit in writing to the Contracting Officer upon completion of the project the measured ground resistance of each ground rod, indicating the location of the rod and the resistance and the soil conditions at the time the measurements were made.
22. **SPARE PARTS.** At least one set of fuses shall be furnished--one minimum of each type and size.



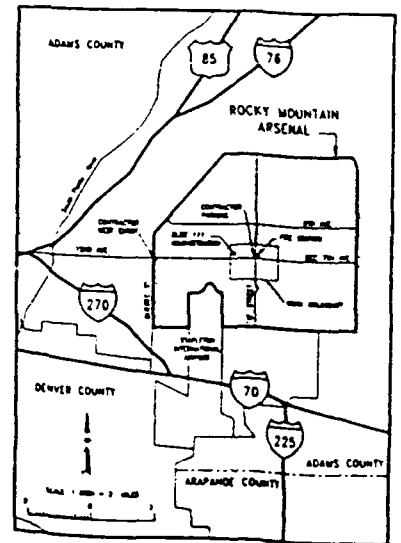
US Army Corps
of Engineers
Omaha District

ROCKY MOUNTAIN ARSENAL SANITARY SEWER INTERIM RESPONSE ACT

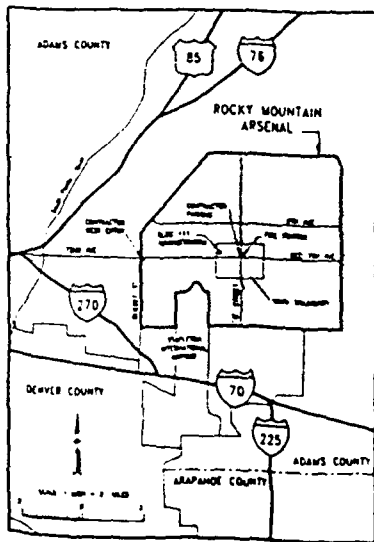
ROCKY MOUNTAIN ARSENAL
COLORADO

1 MAY 1990
ISSUED FOR BID

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ROCKY MOUNTAIN ARSENAL POWER RESPONSE ACTION



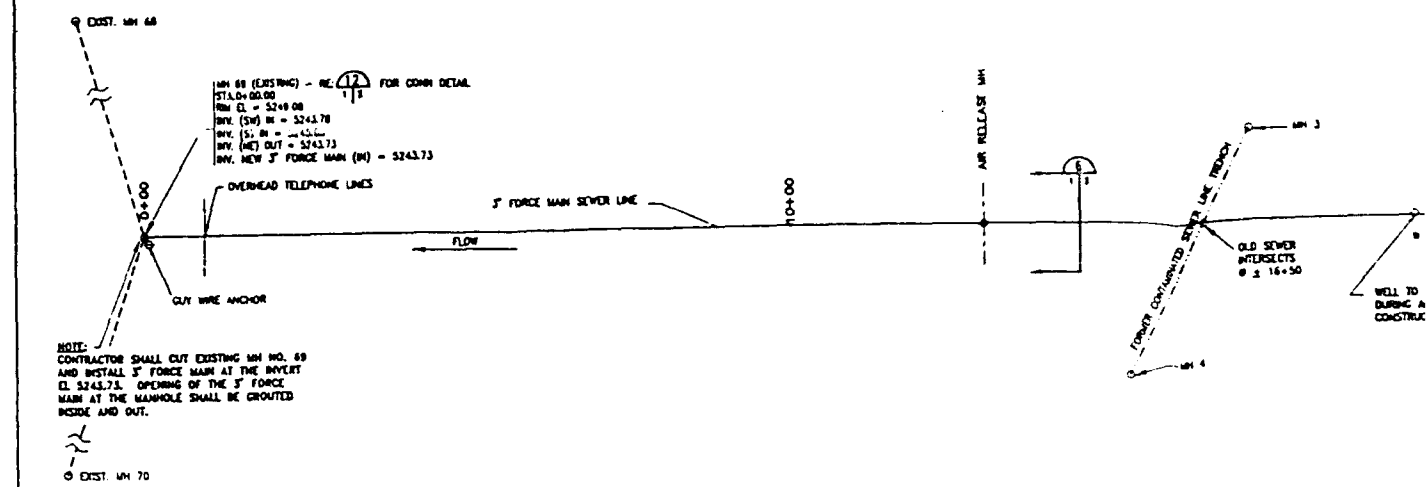
INDEX

DRAWING NUMBER	SH. NO.	DESCRIPTION
E6-2-15	1	FORCE MAIN PLAN AND PROFILE
E6-2-15	2	FORCE MAIN CONSTRUCTION DETAILS
E6-2-15	3	FORCE MAIN ELECTRICAL PLAN

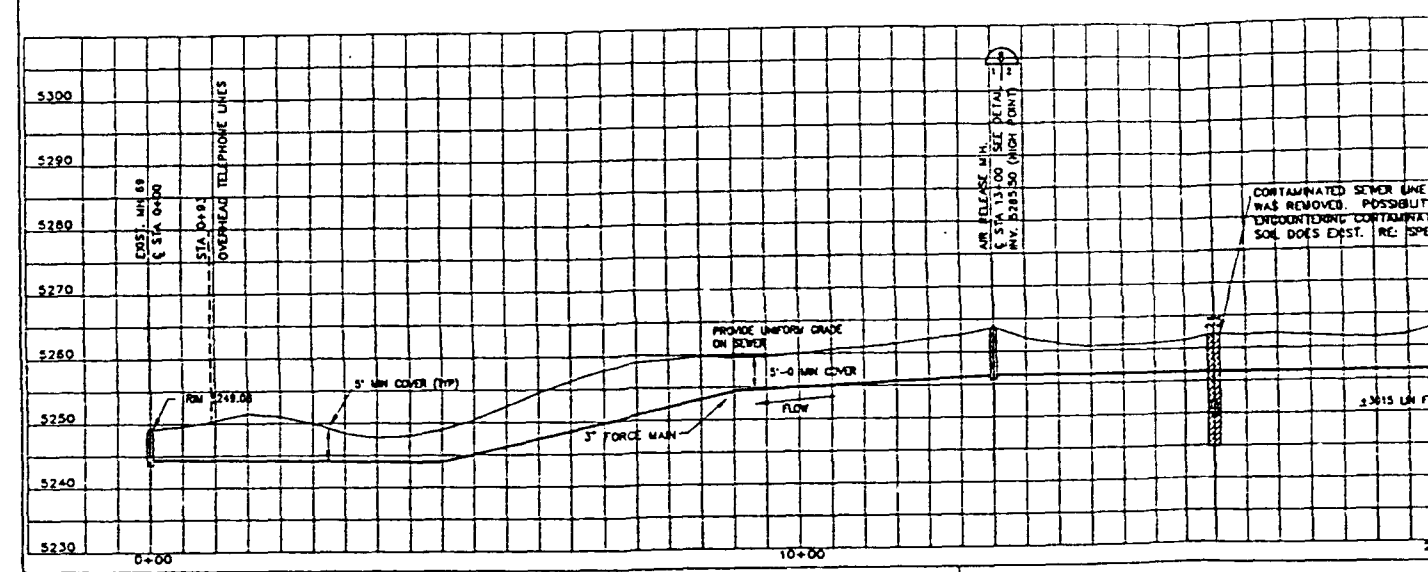
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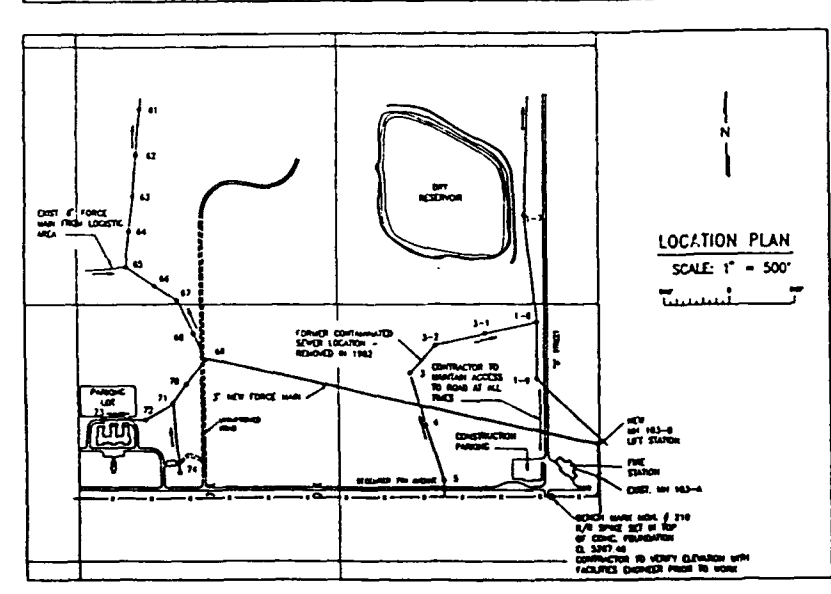
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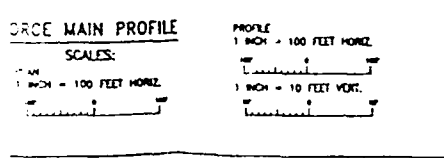
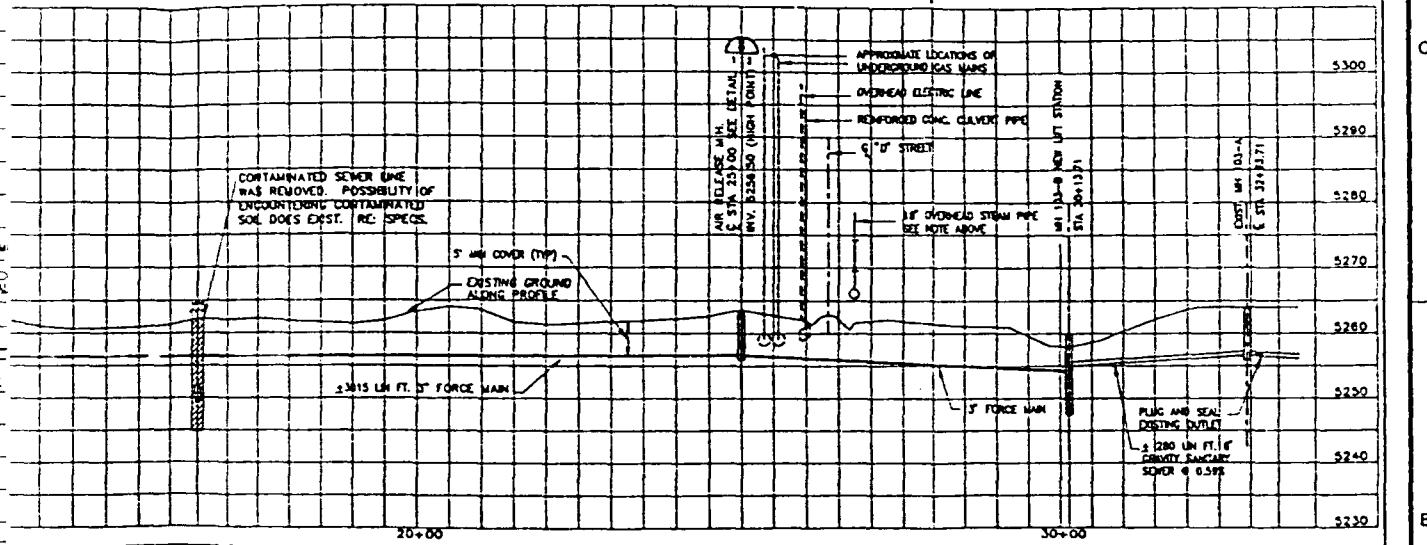
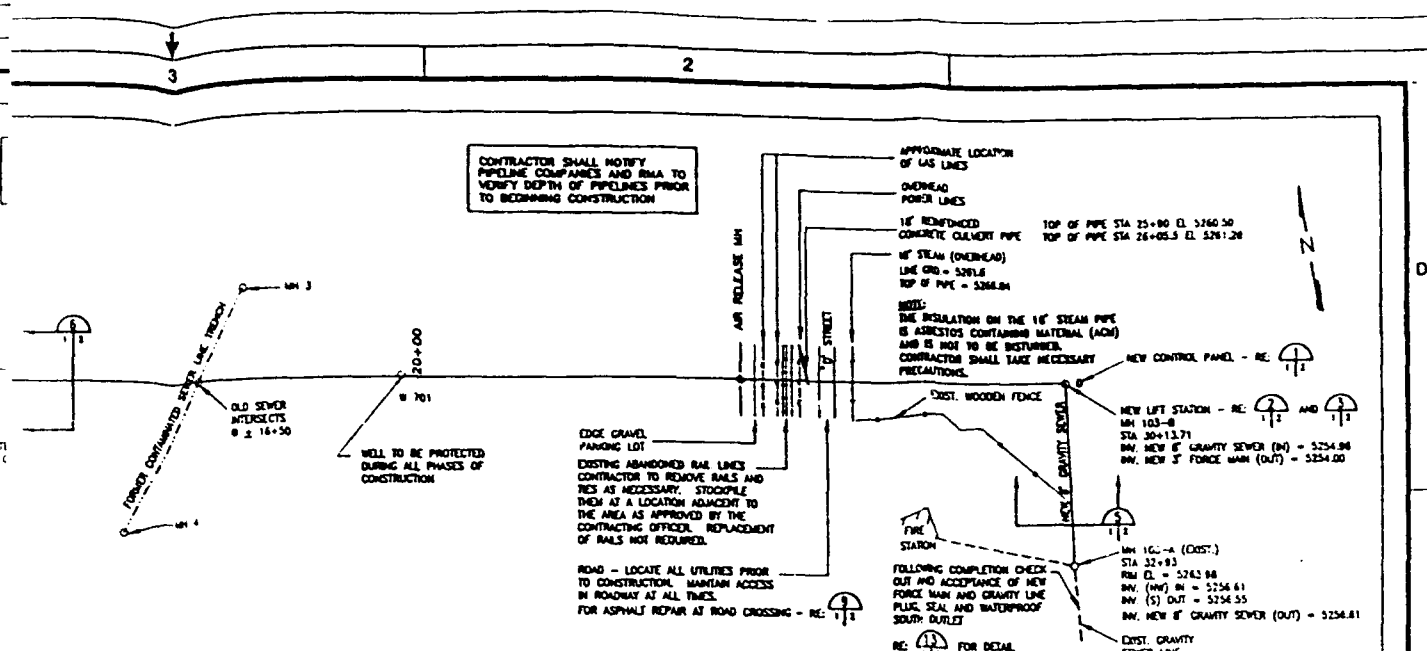
FORCE MAIN PROFILE
 SCALES:
 PLAN 1" = 100 FEET HORIZ.
 PROFILE 1" = 10 FEET VERT.

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3

4

3



LEGEND

- 8" SEWER LINE
- EDGE OF PAVEMENT
- FENCE
- PIPELINE
- POWER LINE
- GAS LINE
- TELEPHONE LINE
- RAILROAD
- MANHOLE
- WELL
- POWER/UTILITY POLE

§§ THINK VALUE ENGINEERING §§

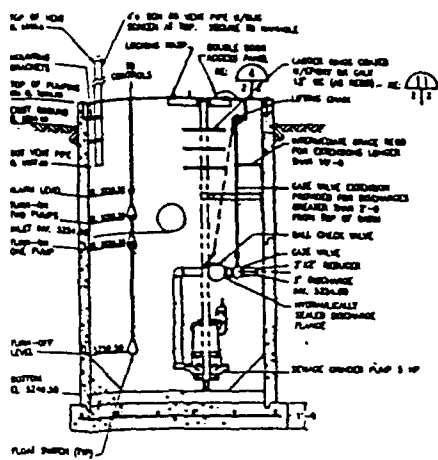
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ROY F. WESTON, INC. DENVER, COLORADO
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA

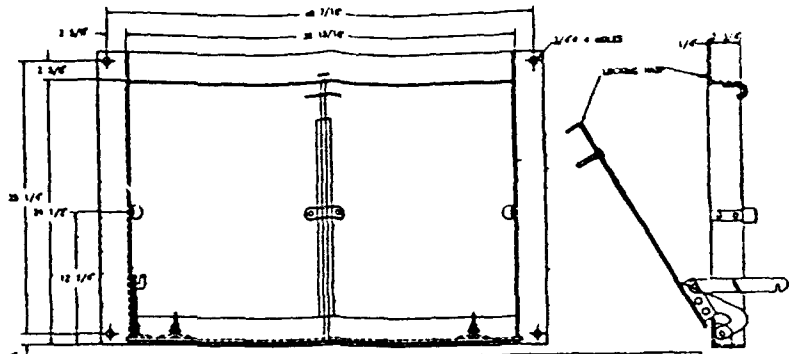
Designed by: PAB/MTN
Drawn by: MFB
Checked by: CPW

ROCKY MOUNTAIN ARSENAL, COLORADO
SANITARY SEWER
FORCE MAIN PLAN AND PROFILE

Reviewed by: Scale: As Shown
Spec. No. Sheet Reference Number: 1 OF 3
Contract No. Date: MAY 1990
Drawing Code: E6-2-15

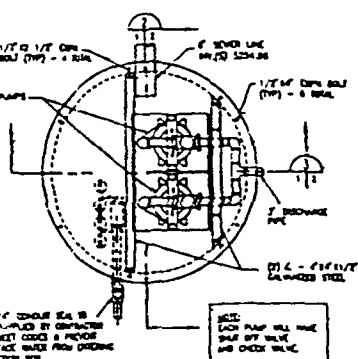


GRINDER PUMP ASSEMBLY IN CONCRETE SUMP
NOT TO SCALE

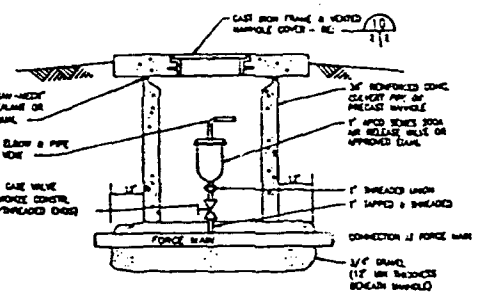


GRINDER PUMP STATION DOOR & FRAME ASSEMBLY
SCALE: 1" = 1'-0"

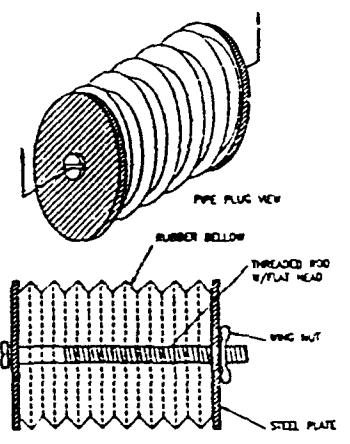
CONCRETE SUMPING SHALL BE 1/2" x 12" x 12" REINFORCED CONCRETE WITH 1/2" x 12" x 12" REINFORCING BARS. PROVIDE PROTECTIVE TOP WITH INCHES DIA. OR PROVIDE SUMP TOP AS SPECIFIED BY 111



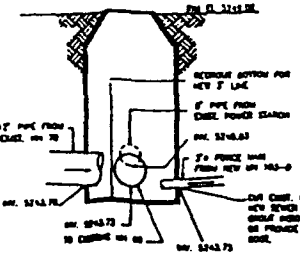
GRINDER PUMP ASSEMBLY IN CONCRETE SUMP
NOT TO SCALE



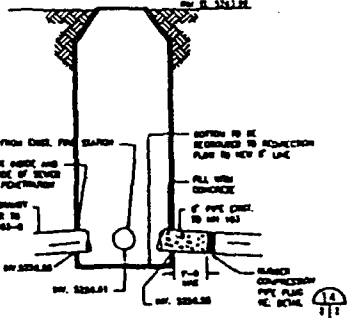
AIR RELEASE MANHOLE DETAIL
NOT TO SCALE



RUBBER COMPRESSION PIPE PLUG DETAIL
NOT TO SCALE



CONNECTING DETAIL FOR EXISTING MANHOLE NO. 69
SCALE: 1/2" = 1'-0"



CONNECTING DETAIL FOR EXISTING MANHOLE NO. 103-A
SCALE: 1/2" = 1'-0"

88 THINK VALUE ENGINEERING 88				
Symbol	Descriptions	Revisions	Date	Approved
ROY F. WESTON, INC. DENVER, COLORADO		U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA		
Designed by: PAB/MTN	ROCKY MOUNTAIN ARSENAL COLORADO SANITARY SEWER			
Drawn by: MFB	FORCE MAIN CONSTRUCTION DETAILS			
Checked by: CPW	Scale: As Shown	Sheet Reference Number:	Date: MAY 1990	
Reviewed by:	Spec. No.	2 OF 3	Drawing Code: E6-2-15	
Submitted by:	Contract No.			
Architect-Engineer				

