

**SPECIFICATIONS**

for

**EROSION CONTROL,  
RECREATION AND ESTHETICS**

Arizona Canal Diversion Channel  
and Skunk Creek

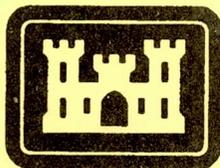
Maricopa County, Arizona

Authority:

Public Law 89-298  
Flood Control Act of 1965

Appropriation:

Construction General  
Contributed Funds, Other



**US Army Corps  
of Engineers**  
Los Angeles District

FLOOD CONTROL DISTRICT	
RECEIVED	
AUG 22 '89	
CH ENGR	P & FM
DEP	HYDRO
ADMIN	LMGT
FINANCE	FILE
C & O	
ENGR	
REMARKS	

*A118556*



14. NAME AND ADDRESS OF OFFEROR (Include ZIP Code)	15. TELEPHONE NO. (Include area code)
CODE	16. REMITTANCE ADDRESS (Include only if different than Item 14)
FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within \_\_\_\_\_ calendar days after the date offers are due. (Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)

AMOUNTS ▶ In accordance with the attached BIDDING SCHEDULE.

18. The offeror agrees to furnish any required performance and payment bonds

**19 ACKNOWLEDGMENT OF AMENDMENTS**  
(The offeror acknowledges receipt of amendments to the solicitation - give number and date of each)

AMENDMENT NO									
DATE									

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER <i>(Type or print)</i>	20B. SIGNATURE	20C. OFFER DATE
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**AWARD (To be completed by Government)**

21. ITEMS ACCEPTED

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22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA
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24. SUBMIT INVOICES TO ADDRESS SHOWN IN <i>(4 copies unless otherwise specified)</i>	ITEM	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO <input type="checkbox"/> 10 U.S.C. 2304(c) ( ) <input type="checkbox"/> 41 U.S.C. 253(c)(1)
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26. ADMINISTERED BY	CODE	27. PAYMENT WILL BE MADE BY
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**CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE**

<input type="checkbox"/> 28. NEGOTIATED AGREEMENT (Contractor is required to sign this document and return _____ copies to issuing office.) Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.	<input type="checkbox"/> 29. AWARD (Contractor is not required to sign this document.) Your offer on this solicitation, is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.
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30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN (Type or print)	31A. NAME OF CONTRACTING OFFICER (Type or print)
30B. SIGNATURE	31B. UNITED STATES OF AMERICA
30C. DATE	BY
	31C. AWARD DATE

Continuation of Standard Form 1442

20D. (1) IF THE OFFEROR IS A JOINT VENTURER, COMPLETE THE FOLLOWING:

_____	_____	_____
(Company Name)	(Signature)	(Title)
_____	_____	_____
(Company Name)	(Signature)	(Title)
_____	_____	_____
(Company Name)	(Signature)	(Title)

NOTE: If a Corporation is participating as a member of a Joint Venture, the Certificate as to Corporate Principal in item (3) below must also be completed and signed.

(2) IF THE OFFEROR IS A PARTNERSHIP, LIST FULL NAME OF ALL PARTNERS

_____	_____
(Name)	(Signature)
_____	_____
(Name)	(Signature)
_____	_____
(Name)	(Signature)

(3) IF THE OFFEROR IS A CORPORATION, THE FOLLOWING CERTIFICATE SHOULD BE COMPLETED:

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, \_\_\_\_\_, certify that I am the \_\_\_\_\_  
 (name)  
 Secretary of the corporation named as offeror in the within offer; that  
 \_\_\_\_\_, who signed said offer on behalf of the corporation,  
 (name)  
 was then \_\_\_\_\_ of said corporation; that the signature thereto  
 (title)  
 is genuine; and that said contract was duly signed, sealed and attested for  
 and in behalf of said corporation by authority of its governing body.

\_\_\_\_\_  
(Name of Corporation)

(Affix)  
(CORPORATE SEAL)

\_\_\_\_\_  
(Secretary)

BIDDING SCHEDULE

<u>Item No.</u>	<u>Description</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>
1.	THUNDERBIRD PASEO	1	Job	L.S.	\$ _____
2.	59TH AVENUE AND THUNDERBIRD ROAD PLAZA	1	Job	L.S.	_____
3.	67TH AVENUE PLAZA AND DESERT INTERPRETIVE GARDEN	1	Job	L.S.	_____
4.	EROSION CONTROL	1	Job	L.S.	_____
5.	SIDE DRAIN, STA. 298+36	1	Job	L.S.	_____
6.	IRRIGATION AUTOMATION	1	Job	L.S.	_____
7.	HARD SURFACE COURTS	1	Job	L.S.	_____
8.	GENERAL PURPOSE PAVED AREA	1	Job	L.S.	_____

TOTAL AMOUNT \$ \_\_\_\_\_

NOTE: Amounts and prices shall be indicated in either figures or words, not both.

Bids shall be submitted on all items of the Bidding Schedule.

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## INSTRUCTIONS TO BIDDERS

### 1. SOLICITATION DEFINITIONS--SEALED BIDDING (JUL 1987) FAR 52.214-1.

"Offer" means "bid" in sealed bidding.

"Solicitation" means an invitation for bids in sealed bidding.

"Government" means United States Government

### 2. AMENDMENT TO INVITATIONS TO BIDS (NOV 1988) FAR 52.214-3.

2.1 If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

2.2 Bidders shall acknowledge receipt of any amendment to the 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 acknowledgement by the time and at the place specified for receipt of bids.

3. FALSE STATEMENT IN BIDS (APR 1984) FAR 52.214-4. 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.

### 4. SUBMISSION OF BIDS (APR 1984) FAR 52.214-5.

4.1 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.

4.2 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.

### 5. DIRECTIONS FOR SUBMITTING BIDS.

5.1 Envelopes containing bids, guarantees, etc., must be sealed, marked, and addressed as follows:

Bid Under Reference No:  
DACW09-89-B-0069

To: U.S. ARMY ENGINEER DISTRICT,  
LOS ANGELES  
ATTN: Contracting Division  
3636 North Central Avenue, Room 760  
Phoenix, Arizona 85012-1936

5.2 Hand carried bids shall be deposited in Room 760, 3636 North Central Avenue, Phoenix, Arizona 85012, prior to the time and date set for opening of bids or may be delivered to Room 760 immediately prior to bid opening time.

5.3 Telegraphic Modifications to Bids should be addressed to:

U.S. Army Engineer District, Los Angeles  
Room 760  
3636 North Central Avenue  
Phoenix, Arizona 85012

5.4 Modifications to bids submitted by facsimile (telecopier) or teletype are not authorized and will not be considered.

6. EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984) FAR 52.214-6. 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 the information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

7. LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (APR 1984) FAR 52.214-7.

7.1 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:

7.1.1 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

7.1.2 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.

7.2 Any modification or withdrawal of a bid is subject to the same conditions as in paragraph 7.1 above.

7.3 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.

7.4 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.

7.5 Notwithstanding paragraph 7.1 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.

7.6 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.

#### 8. PREPARATION OF BIDS-CONSTRUCTION (APR 1984) FAR 52.214-18.

8.1 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.

8.2 The bid form may require bidders to submit bid prices for one or more items on various bases, including:

- (1) Lump sum bidding;
- (2) Alternate prices;
- (3) Units of construction; or
- (4) Any combination of subparagraphs (1) through (3) above.

8.3 If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

8.4 Alternate bids will not be considered unless this solicitation authorizes their submission.

#### 9. CONTRACT AWARD-SEALED BIDDING-CONSTRUCTION (FEB 1986) FAR 52.214-19.

9.1 The Government will evaluate bids in response to this solicitation without discussions and will award a contract resulting from this solicitation to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

9.2 The Government may reject any or all bids, and waive informalities or minor irregularities in bids received.

9.3 The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

#### 10. BID GUARANTEE (APR 1984) FAR 52.228-1.

10.1 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.

10.2 The offeror (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.

10.3 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 a bond(s) as required by the solicitation within the time specified, the Contracting Officer may terminate the contract for default.

10.4 Unless otherwise specified in the bid, the bidder will (1) allow 60 days for acceptance of its bid and (2) give bond within 10 days after receipt of the forms by the bidder.

10.5 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.

11. AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) (APR 1984) FAR 52.210-2. Single copies of specifications cited in this solicitation may be obtained by submitting a written request to the supply point listed below. The request must contain the title of the specification, its number, date, applicable amendment(s), and the solicitation or contract number. In case of urgency, telephone or telegraphic requests are acceptable. Voluntary standards, which are not available to offerors and contractors from Government sources, may be obtained from the organization responsible for their preparation, maintenance, or publication.

Commanding Officer  
U.S. Naval Publication and Forms Center  
5801 Tabor Avenue  
Philadelphia, PA 19120  
Telex Number..... 834295  
Western Union Number.... 710-670-1685  
Telephone Number..... (215) 697-3321

12. AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS, STANDARDS, PLANS, DRAWINGS, DATA ITEM DESCRIPTIONS, AND OTHER PERTINENT DOCUMENTS (JUN 1977) DFARS 252.236-7082. The specification, standards, plans, drawings, descriptions, and other pertinent documents cited in this solicitation may be examined at the following locations:

Brunswick Square Building  
Plan Room, Room 300  
360 East Second Street  
Los Angeles, California 90013

13. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE, EFARS 52.2/9108(f). 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. A copy

of EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule" is available for review at Room 7216, 300 North Los Angeles Street, Los Angeles, California.

14. SMALL BUSINESS AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING. Bidders are cautioned that failure to comply in good faith with the CONTRACT CLAUSES entitled (1) "Utilization of Small Business Concerns and Small Disadvantaged Business Concerns" and (2) "Small Business and Small Disadvantaged Business Subcontracting Plan (Alternate I)", when applicable, will be a material breach of contract. In order to assist prime contractors in developing a source list of Small and Small Disadvantaged Business Concerns, you are encouraged to contact minority Contractor associations, the Minority Business Development Agency, and the appropriate General Business Service Centers in your Standard Metropolitan Statistical Area, addresses of which may be obtained from:

Write: U.S. Army Engineer District, Los Angeles  
ATTN: CESPL-DE-B  
P.O. Box 2711  
Los Angeles, California 90053-2325

Telephone: Alice Tafoya  
Small and Disadvantaged Business Utilization Specialist  
Area Code (213) 894-4920

15. ADDITIONAL INFORMATION pertaining to these plans and specifications may be obtained by writing or calling (collect calls not accepted) U.S. Army Engineer District, Los Angeles, Attn: Mr. G.E. Davis, P.O. Box 2711, Los Angeles, California 90053-2325. Telephone (213) 894-5493.

15.1 All inquiries after bid opening should be directed to: Mr. B.J. Meirowsky. Telephone (213) 894-5660. By mail: P.O. Box 2711, Los Angeles, California 90053-1325. In person: Brunswig Square Building, Room 308, 360 East Second Street, Los Angeles, California 90013.

15.2 Bid Results may be obtained by calling (213) 894-3638.

16. SITE INSPECTION. Arrangements for visiting the site may be made by contacting: Neil Erwin, Maricopa County Civil Works Resident Office, (602) 261-3022.

17. DRAWINGS. Specifications with half-size drawings will be furnished upon receipt of payment of \$25.00 per set. Full-size drawings will be furnished upon receipt of payment of \$100.00 per set. If individual plan sheets are requested, they will be furnished at the rate of \$0.70 for full-size for each sheet requested, but with a minimum charge of \$1.00. The maximum charge shall not exceed the charge for a full set of plans. No refund of the payment for drawings will be made and the drawings need not be returned to the District Engineer. Additional copies of the specifications alone will be furnished an applicant at the rate of \$5.00 per copy. Payments will be made by check or money order and mailed to the U.S. Army Engineer District, Los Angeles, P.O. Box 2711, Los Angeles, California 90053-2325. Checks and money orders should be made payable to "FAO, U.S. Army, Los Angeles District". Over the counter purchases of plans and specifications may be made at Brunswig Square Building, Room 300, 360 East Second Street, Los Angeles, California 90013.

18. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (APR 1984) FAR 52.222-23.

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

18.2 The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
25.0 to 30.0%	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

18.3 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.

18.4 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.

18.5 As used in this Notice, and any contract resulting from this solicitation, the "covered area" is Maricopa County, Arizona.

19. BONDS.

19.1 Bid Bonds. Each Bidder shall submit with his bid a Bid Bond (Standard Form 24) with good and sufficient surety or surities acceptable to the Government, or other security as provided in paragraph: BID BOND hereinbefore, in the form of twenty percent (20%) of the bid price or \$3,000,000, whichever is lesser. The Bid Bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents.

19.2 Performance and Payment Bonds. After the perscribed forms have been presented to the bidder to whom award is made for signature, two bonds, each with good and sufficient surety or sureties acceptable to the Government, shall be furnished; namely a Performance Bond (Standard Form 25) and a Payment Bond (Standard Form 25A). The penal sums of such bonds will be as follows:

19.2.1 Performance Bond. The penal sum shall equal one hundred percent (100%) of the contract price.

19.2.2 Payment Bond.

19.2.2.1 When the contract price is \$1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.

19.2.2.2 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.

19.2.2.3 When the contract price is more than \$5,000,000, the penal sum shall be \$2,500,000.

19.3 Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of Contract performance.

NOTE: For contracts less than \$25,000, Bid Bonds, and Performance and Payment Bonds are not required.

20. EQUAL OPPORTUNITY PREAWARD CLEARANCE OF SUBCONTRACTORS (APR 1984) FAR 52.222-28. Notwithstanding the clause of this contract entitled "Subcontractors," the Contractor shall not enter into a first-tier subcontract for an estimated or actual amount of \$1 million or more without obtaining in writing from the Contracting Officer a clearance that the proposed subcontractor is in compliance with equal opportunity requirements and therefore is eligible for award.

21. ARITHMETIC DISCREPANCIES (1985 JAN HQ USACE) EFARS 14.201/90.

21.1 For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the Bidding Schedule as submitted by bidders:

(a) Obviously misplaced decimal points will be corrected;

(b) In case of discrepancy between unit price and extended price, the unit price will govern;

(c) Apparent errors in extension of unit prices will be corrected; and

(d) Apparent errors in addition of lump-sum and extended prices will be corrected.

21.2 For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bids to be evaluated on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

## 22. SERVICE OF PROTESTS (NOV 1988) FAR 52.233-2.

22.1 Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with General Accounting Office (GAO) or the General Services Administration Board of Contract Appeals (GSBCA), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from the Chief, Contracting Division, or his authorized representative, Brunswig Square Building, Room 308, 360 East Second Street, Los Angeles, California, 90013.

22.2 The copy of any protest shall be received in the office designated above on the same day a protest is filed with the GSBCA or within one day of filing a protest with the GAO.

23. CONTRACTOR BUSINESS INTEGRITY. 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.

\* \* \* \* \*

REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF BIDDER

1. CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985) FAR 52.203-2.

(a) The Offeror certifies that-

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other Offeror or competitor relating to (i) those prices, (ii) the intention to submit an offer, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this offer have not been and will not be knowingly disclosed by the Offeror, directly or indirectly, to any other Offeror or Bidder 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) No attempt has been made or will be made by the Offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory-

(1) Is the person in the Offeror's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above

(insert full name of person(s) in the Offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the Offeror's organization);

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above.

(c) If the Offeror deletes or modifies subparagraph (a)(2) above, the Offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

2. CONTINGENT FEE REPRESENTATION AND AGREEMENT (APR 1984) FAR 52.203-4.

(a) Representation. The Offeror represents that, except for full-time bona fide employees working solely for the Offeror, the Offeror-

(Note: The Offeror must check the appropriate boxes. For interpretation or the representation, including the term "bona fide employee," see Subpart 3.4 of the Federal Acquisition Regulation.)

(1)  has,  has not employed or retained any person or company to solicit or obtain this contract; and

(2)  has  has not paid or agreed to pay to any person or company employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

(b) Agreement. The Offeror agrees to provide information relating to the above Representation as requested by the Contracting Officer and, when subparagraph (a)(1) or (a)(2) is answered affirmatively, to promptly submit to the Contracting Officer-

- (1) A completed Standard Form 119, Statement of Contingent or Other Fees, (SF 119); or
- (2) A signed statement indicating that the SF 119 was previously submitted to the same contracting office, including the date and applicable solicitation or contract number, and representing that the prior SF 119 applies to this offer or quotation.

3. TYPE OF BUSINESS ORGANIZATION-SEALED BIDDING (JUL 1987) FAR 52.214-2.

The bidder, by checking the applicable box, represents that --

- (a) It operates as  a corporation incorporated under the laws of the State of \_\_\_\_\_,  an individual,  a partnership,  a nonprofit organization, or  a joint venture; or
- (b) If the bidder is a foreign entity, it operates as  an individual,  a partnership,  a nonprofit organization,  a joint venture, or  a corporation, registered for business in \_\_\_\_\_ country

4. PARENT COMPANY AND IDENTIFYING DATA (APR 1984) FAR 52.214-8.

- (a) A "parent" company, for the purpose of this provision, is one that owns or controls the activities and basic business policies of the bidder. To own the bidding company means that the parent company must own more than 50 percent of the voting rights in that company. A company may control a bidder as a parent even though not meeting the requirement for such ownership if the parent company is able to formulate, determine, or veto basic policy decisions of the Offeror through the use of dominant minority voting rights, use of proxy voting or otherwise.
- (b) The bidder  is,  is not (check applicable box) owned or controlled by a parent company.
- (c) If the bidder checked "is" in paragraph (b) above, it shall provide the following information:

Name and Main Office Address  
of Parent Company  
(including Zip Code)

Parent Company's Employer's  
Identification Number

- (d) If the bidder checked "is not" in paragraph (b) above, it shall insert its own Employer's Identification Number on the following line \_\_\_\_\_.

5. SMALL BUSINESS CONCERN REPRESENTATION (MAY 1986) FAR 52.219-1.

The Offeror represents and certifies as part of its offer that it  is,  is not a small business concern and that  all,  not all end items to be furnished will be manufactured or produced by a small business concern in the United States, its territories or possessions, Puerto Rico, or the Trust Territory of the Pacific Islands. "Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the size standards in this solicitation.

6. SMALL DISADVANTAGED BUSINESS CONCERN REPRESENTATION (DoD FAR SUPPLEMENT DEVIATION) (JUN 1988) DFARS 252.219-7005.

(a) Definition. "Small disadvantaged business concern," as used in this provision, means a small business concern, including mass media, owned and controlled by individuals who are both socially and economically disadvantaged, as defined in regulations prescribed by the U.S. Small Business Administration at 13 CFR Part 124, the majority of earnings of which directly accrue to such individuals. (13 CFR Part 124 generally provides that a small disadvantaged business concern is a small business concern (1) which is at least fifty-one percent (51%) owned by one or more socially and economically disadvantaged individuals; or in the case of any publicly owned business, at least fifty-one percent (51%) of the voting stock of which is owned by one or more socially and economically disadvantaged individuals, and (2) whose management and daily business operations are controlled by one or more such individuals.) (See 13 CFR 124.101 through 124.110.)

(b) Representation. The Offeror represents that its qualifying ownership falls within at least one of the following categories, as defined in 13 CFR 124 (check the applicable categories):

- \_\_\_\_\_ Subcontinent Asian (Asian-Indian) American (US Citizen) originally from India, Pakistan, Bangladesh, or Sri Lanka)
- \_\_\_\_\_ Asian-Pacific American (US Citizen with origins from Japan, China, The Philippines, Vietnam, Korea, Samoa, Guam, U.S. Trust Territory of the Pacific Islands, Northern Mariana Islands, Laos, Cambodia, or Taiwan)
- \_\_\_\_\_ Black American (US Citizen)
- \_\_\_\_\_ Hispanic American (US Citizen with origins from South America, Central America, Mexico, Cuba, the Dominican Republic, Puerto Rico, Spain or Portugal)
- \_\_\_\_\_ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians)
- \_\_\_\_\_ Individual/concern currently certified for participation in the Minority Small Business and Capital Ownership Development Program under section 8(a) of the Small Business Act (15 U.S.C. 637(a))
- \_\_\_\_\_ Other (in addition to (c)(1), Offeror must complete (c)(2) below)

(c) Certification.

- (1) The Offeror represents and certifies, as part of its offer, that it is \_\_\_\_\_, is not \_\_\_\_\_ a small disadvantaged business concern.
- (2) (Complete only if item (b) above is checked "Other")

The Offeror represents and certifies, as part of its offer, that the Small Business Administration (SBA) has \_\_\_\_\_, has not \_\_\_\_\_ made a determination concerning the Offeror's status as a small disadvantaged business concern. If the SBA has made such a determination, the date of the determination was \_\_\_\_\_ and the Offeror certifies that it was \_\_\_\_\_, was not \_\_\_\_\_ found by the SBA to be socially and economically disadvantaged as a result of that determination and that no circumstances have changed to vary that determination.

(d) Notification. The Offeror agrees to notify the Contracting Officer before award of any change in its status as a small disadvantaged business concern occurring between the submission of its offer and contract award.

(e) Penalty. The Offeror represents and certifies that the above information is true and understands that whoever for the purpose of securing a contract or subcontract under subsection (a) of Section 1207 of Public Law 99-661 misrepresents the status of any concern or person as a small business concern owned and controlled by a minority (as described in subsection (a)) shall be punished by a fine of not less than \$10,000 or by imprisonment for not more than a year, or both.

7. WOMEN-OWNED SMALL BUSINESS REPRESENTATION (APR 1984) FAR 52.219-3.

(a) Representation. The Offeror represents that it  is,  is not a women-owned small business concern.

(b) Definitions.

"Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards in 13 CFR 121.

"Women-owned," as used in this provision, means a small business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business.

8. CERTIFICATION OF NONSEGREGATED FACILITIES (APR 1984) FAR 52.222-21.

(a) "Segregated facilities," as used in this provision, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise.

(b) By the submission of this offer, the Offeror certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Offeror agrees that a breach of this certification is a violation of the Equal Opportunity clause in the contract.

(c) The Offeror further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will-

(1) Obtain identical certifications from proposed subcontractors before the award of subcontracts under which the subcontractor will be subject to the Equal Opportunity clause;

(2) Retain the certifications in the files; and

(3) Forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES.

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

**NOTE:** The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

9. PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (APR 1984) FAR 52.222-22.

The Offeror represents that-

(a) It  has,  has not participated in previous contract or subcontract subject either to the Equal Opportunity clause of this solicitation, the clause originally contained in Section 310 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114;

- (b) It  has,  has not, filed all required compliance reports; and  
(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

10. CLEAN AIR AND WATER CERTIFICATION (APR 1984) FAR 52.223-1.

The Offeror certifies that-

- (a) Any facility to be used in the performance of this proposed contract is , is not  listed on the Environmental Protection Agency List of Violating Facilities;  
(b) The Offeror will immediately notify the Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the Environmental Protection Agency, indicating that any facility that the Offeror proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and  
(c) The Offeror will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

11. DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER REPORTING (DEC 1980) DFARS 252.204-7004.

In the block with its name and address, the Offeror should supply the Data Universal Numbering System (DUNS) Number applicable to that name and address. The DUNS Number should be preceded by "DUNS:". If the Offeror does not have a DUNS Number, it may obtain one from any DUN and Bradstreet branch office. No Offeror should delay the submission of its offer pending receipt of its DUNS Number.

12. PREFERENCE FOR LABOR SURPLUS AREA CONCERNS (NOV 1987) DFARS 252.209-700.

(a) This acquisition is not set aside for labor surplus area (LSA) concerns. However, the Offeror's status as such a concern may affect (1) entitlement to award in case of tie offers or (2) offer evaluation in accordance with the Buy American Act clause of this solicitation. In order to determine whether the Offeror is entitled to a preference under (1) or (2) above, the Offeror must identify, below, the LSA in which the costs to be incurred on account of manufacturing or production (by the Offeror or the first-tier subcontractors) amount to more than 50 percent of the contract price.

---

(b) Failure to identify the locations as specified above will preclude consideration of the Offeror as an LSA concern. If the Offeror is awarded a contract as an LSA concern and would not have otherwise qualified for award, the Offeror shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

13. CERTIFICATION OR DISCLOSURE OF OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT THAT SUPPORTS TERRORISM (NOV 1987) DFARS 252.209-7000.

- (a) "Significant interest" as used in this provision means  
(1) Ownership of or beneficial interest in five percent (5%) or more of the firm's or subsidiary's securities. Beneficial interest includes holding five percent (5%) or more of any class of the firm's securities in "nominee shares", "street names", or some other method of holding securities that does not disclose the beneficial owner;

- (2) Holding a management position in the firm such as director or officer;
- (3) Ability to control or influence the election or appointment of directors or officers of the firm;
- (4) Ownership of ten percent (10%) or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or
- (5) Holding fifty percent (50%) or more of the indebtedness of a firm.

(b) Unless paragraph (c) below has been completed, the Offeror, by submission of its offer, certifies, to the best of its knowledge and belief, that no government of a foreign country, or agent or instrumentality of a foreign country, listed below, has, directly or indirectly, a significant interest in the Offeror or, if the Offeror is a subsidiary, in the firm that owns or controls, directly or indirectly, the Offeror. Such countries currently include:

- (1) Cuba;
- (2) Iran;
- (3) Libya;
- (4) Syria; and
- (5) South Yemen.

(c) If the Offeror is unable to certify in accordance with (b) above, the Offeror represents that the following country or countries (listed in (b) above) or an agent or instrumentality of such country or countries, have a significant interest in the Offeror's firm:

Country \_\_\_\_\_  
 Significant Interest \_\_\_\_\_

14. TAXPAYER IDENTIFICATION (NOVEMBER 1988) FAR 52.204-3.

(a) Definitions.

"Common parent", as used in this solicitation provision, means an offeror that is a member of an affiliated group of corporations that files its Federal income tax returns on a consolidated basis.

"Corporate status", as used in this solicitation provision, means a designation as to whether the offeror is a corporate entity, an unincorporated entity (e.g., sole proprietorship or partnership), or a corporation providing medical and health care services.

"Taxpayer Identification Number (TIN)", as used in this solicitation provision, means the number required by the IRS to be used by the Contractor in reporting income tax and other returns.

(b) The Offeror is required to submit the information required in paragraphs (c) through (e) of this solicitation provision in order to comply with reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M and implementing regulations issued by the Internal Revenue Service (IRS). If the resulting contract is subject to reporting requirements described in FAR 4.902(a), the failure or refusal by the Offeror to furnish the information may result in a 20 percent reduction of payments otherwise due under the contract.

(c) Taxpayer Identification Number (TIN).

TIN: \_\_\_\_\_

TIN has been applied for.

TIN is not required because:

Offeror is a nonresident alien, foreign corporation or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the U.S. and does not have an office or place of business or a fiscal paying agent in the U.S.;

Offeror is an agency or instrumentality of a foreign government;

Offeror is an agency or instrumentality of a state or local government;

Other. State Basis. \_\_\_\_\_

(d) Corporate Status.

- Corporation providing medical and health care services or engaged in the billing and collecting of payments for such services
- Other corporate entity
- Not a corporate entity
- Sole proprietorship
- Partnership
- Hospital or extended care facility described in 26 CFR 501(c)(3) that is exempt from taxation under 26 CFR 501(a)

(e) Common Parent.

Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

Name and TIN of common parent:

Name: \_\_\_\_\_

Tin: \_\_\_\_\_

15. SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVE DEMONSTRATION PROGRAM (JAN 1989) DFARS 252.219-7012.

(a) Definition.

"Emerging Small Business", as used in this solicitation, means a Small Business Concern whose size is no greater than 50 percent (50%) of the numerical size standard applicable to the standard industrial classification code assigned to a contracting opportunity.

(b) (Complete only if offeror has certified itself under the clause at FAR 52.219-1 as a small business concern under the size standards of this solicitation.)

The offeror represents and certifies as part of its offer that it is , is not , an emerging small business.

(c) (Complete only if the offeror is a Small Business or an Emerging Small Business, indicating its size range.)

Offeror's number of employees for the past twelve months or offeror's average gross revenue for the last three fiscal years. (Check one of the following:)

No. of Employees	Ave. Annual Gross Revenues
50 or fewer	\$1 Million or less
51 - 100	\$1,000,001 - \$2 Million
101 - 250	\$2,000,001 - \$3.5 Million
251 - 500	\$3,500,001 - \$5 Million
501 - 750	\$5,000,001 - \$10 Million
751 - 1,000	\$10,000,001 - \$17 Million
over 1,000	over \$17 Million

16. CERTIFICATION REGARDING A DRUG-FREE WORKPLACE (MAR 1989) FAR 52.223-5.

(a) Definitions. As used in this provision:

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Drug free workplace" means a site for the performance of work done in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract.

"Individual" means an offeror/Contractor that has no more than one employee including the offeror/Contractor.

(b) By submission of its offer, the offeror, if other than an individual, who is making an offer that equals or exceeds \$25,000, certifies and agrees, that with respect to all employees of the offeror to be employed under a contract resulting from this solicitation, it will --

(1) Publish a statement notifying such employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish a drug-free awareness program to inform such employees about --

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this provision;

(4) Notify such employees in the statement required by subparagraph (b)(1) of this provision, that as a condition of continued employment on the contract resulting from this solicitation, the employee will --

(i) Abide by the terms of the statement; and

(ii) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction;

(5) Notify the Contacting Officer within ten (10) days after receiving notice under subdivision (b)(4)(ii) of this provision, from an employee or otherwise receiving actual notice of such conviction; and

(6) Within thirty (30) days after receiving notice under subparagraph (a)(4) of this provision of a conviction, impose the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace:

(i) Take appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employees to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by the Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this provision.

(c) By submission of its offer, the offeror, if an individual who is making an offer of any dollar value, certifies and agrees that the offeror will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in the performance of the contract resulting from this solicitation.

(d) Failure of the offeror to provide the certification required by subparagraphs 17.2 or 17.3 of this provision, renders the offeror unqualified and ineligible for award. (See FAR 9.104-1(g) and 19.602-1(a)(2)(i)).

(e) In addition to other remedies available to the Government, the certification in paragraphs (b) and (c) of this provision concerns a matter within the jurisdiction of an agency of the United States and the making of false, fictitious, or fraudulent certifications may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

CLAUSES INCORPORATED BY REFERENCE (APR 1984) FAR 52.252-2.

This contract incorporates the following clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

- I. FEDERAL ACQUISITION REGULATIONS (48 CFR CHAPTER 1) CLAUSES.
- II. ENGINEER FEDERAL ACQUISITION REGULATION SUPPLEMENT (EFARS) CLAUSES.
- III. DEPARTMENT OF DEFENSE FAR SUPPLEMENT (DFARS) (48 CFR CHAPTER 2) CLAUSES.

(END OF CLAUSE)

These clauses may be obtained by mail from Contracting Division, P.O. Box 2711, Los Angeles, California, 90053-2325, or in person at Brunswig Square Building, 360 East Second Street, Room 300, Los Angeles, California, 90013.

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**CONSTRUCTION-INSIDE THE U.S**  
**Issued by: Department of the Army, Corps of Engineers**  
**Edition of 12 DEC 88**

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U.S. Department of Labor



GENERAL WAGE DECISION NO. AZ89-1

Supersedes General Wage Decision No. AZ88-1

State: ARIZONA

County(ies): Maricopa

Construction Type: Building

Construction Description: ~~Building Projects~~ (does not include single family homes and apartments up to and including 4 stories)

Modification Record:

No.  
1

Publication Date  
Mar. 31, 1989

Page No.(s)  
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AZ89-1

	Basic Hourly Rates	Fringe Benefits
<b>ASBESTOS WORKERS:</b>		
Commercial	14.00	3.33
Industrial	19.68	4.50
<b>BOILERMAKERS</b>		
	18.86	4.50
<b>BRICKLAYERS; Stonemasons</b>		
	11.50	3.04
<b>CARPENTERS:</b>		
Carpenters; Saw Filer; Shingler; and Drywall; Hangers	15.665	2.55
Floor Layer and Piledriver	16.01	2.55
Millwrights	16.29	2.59
<b>GEMENT MASONS:</b>		
Cement Masons	13.99	3.05
Concrete Troweling ; Sawing and Scor- ing, Curb and Gutter, Grinding Ma- chine Operator; Clary and similar type of power Screed; Color pigment; Steps: Composition Finisher	14.20	3.05
<b>DRYWALL TAPERS</b>		
	15.06	1.20
<b>ELECTRICIANS:</b>		
Electricians	12.18	1.32
Sound Installers	16.00	2.14+ 3%
<b>ELEVATOR CONSTRUCTORS:</b>		
Mechanics	16.62	4.32+ a
Helpers	11.63	4.32+ a
Probationary Helpers	8.31	
<b>GLAZIERS</b>		
	15.39	1.78
<b>INSULATION INSTALLERS</b>		
	8.57	
<b>*IRONWORKERS</b>		
	16.00	5.40
<b>LABORERS</b>		
	7.55	
<b>LANDSCAPE SPRINKLER FITTER/INSTALLER</b>		
	6.65	
<b>LANDSCAPE LABORER</b>		
	4.59	
<b>LINE CONSTRUCTION:</b>		
Groundmen	13.41	4.75+ 3.5%
Equipment Operator; Powdermen & Mech- anics	15.83	4.75+ 3.5%
Linemen, Crane Operator, Sagger, and Pilot	18.15	4.75+ 3.5%
Cable splicers	18.66	4.75+ 3.5%
<b>PAINTERS:</b>		
Brush and Roller; Sandblaster (No- zzleman); Sheetrock Taper; Floor Coverer; Sandblaster (pot tender)	13.54	1.30
Spray; Paperhanger	13.79	1.30
Creosote Applier	13.87	1.30
Swing Stage:		
Brush; Sandblaster	13.94	1.30
Spray	14.19	1.30
Steeplejack	14.40	1.30
Steel and Bridge, Brush; Nozzle- man and Pot Tender; Steel (steam cleaner); Electric and Air Tool Operator; Steel Sandblaster	14.47	1.30
Steel and bridge, Spray	14.67	1.30



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PLASTERERS	15.69	3.06
*PLUMBERS	16.50	4.33
ROOFERS	10.84	2.11
SHEET METAL WORKERS	16.50	3.30
SOFT FLOOR LAYERS	12.46	.92
SPRINKLER FITTERS	19.28	3.80
TILE, MARBLE, and TERRAZZO WORKERS	13.74	2.76
TILE FINISHERS	11.77	1.79
POWER EQUIPMENT OPERATORS:		
Group 1	11.05	3.28
Group 2	13.55	3.28
Group 3	14.13	3.28
Group 4	14.80	3.28
Group 5	15.62	3.28
Group 6	16.43	3.28
Group 7	16.90	3.28
Group 8	17.41	3.28
Group 9	18.34	3.28
TRUCK DRIVERS:		
Group 1	13.10	2.87
Group 2	13.30	2.87
Group 3	13.64	2.87
Group 4	14.15	2.87
Group 5	14.41	2.87
Group 5A	14.71	2.87
Group 6	14.92	2.87
Group 7	15.54	2.87
Group 8	16.34	2.87
Group 8A	17.67	2.87
Group 8B	16.85	2.87
Group 8C	17.71	2.87

FOOTNOTE:

- a. Employer contributes 8% of basic hourly rate for 5 years' service and 6% basic hourly rate for 6 months' to 5 years' service as Vacation Pay Credit. Seven Paid Holidays: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Friday after Thanksgiving; and Christmas Day

WELDERS- Receive rate prescribed for craft performing operation to which welding is incidental.

POWER EQUIPMENT OPERATORS

Group 1: Air Compressor Operator; Pump Operator; Conveyor Operator; Generator Operator (all); Power Grizzly Operator; Fireman (all); Welding Machine Operator; Tripper Operator; Concrete Mixer Operator, skip type; Highline Cableway Signalman

Group 2: Oiler; Forklift and Ross Carrier Operator; Skiploader, 1 1/2 cu. yd. and less; Pavement Breaker; Roller Operator (except as otherwise classified); Wheel-type Tractor Operator (Ford-Ferguson type); Slurry Seal Machine Operator (driver Moto-paver); Power Sweeper



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- Group 3: Self-propelled Chip Spreading Machine; Conveyor Operator; Dinky Operator, under 20 ton; Elevator Hoist Operator, Husky and similar
- Group 4: Motor Crane Driver; Beltcrete Operator; Curing Machine Operator, Boring Bridge and Texture; Cross Tineing and Pipe Float; Straw Blower; Hydrographic Seeder; Hydrographic Mulcher; Jumbo Finishing Machine; Joint Inserter
- Group 5: A-Frame Boom Truck or Winch Truck Operator; Grade Checker (excluding Civil Engineer); Multiple Power Concrete Saw Operator; Screed Operator; Stationary Pipe Wrapping and Cleaning Machine Operator; Tugger Operator
- Group 6: Aggregate Plant Operator (including crushing, screening, and sand plants, etc.); Asphalt Laydown Machine Operator; Asphalt Plant Mixer Operator; Boring Machine Operator; Concrete Mechanical Tamping, Spreading or Finishing Machine Operator (including Clary, Johnson or similar types); Concrete Pump Operator; Concrete Batch Plant Operator, all types and sizes; Conductor, Brakeman, or Handler; Drilling Machine Operator, all types and sizes except as otherwise classified; Field Equipment Serviceman; Kolman Belt Loader Operator or similar type, with belt width 48" or over; Locomotive Engineer (including Dinky 20 tons weight and over); Moto-paver and similar type equipment Operator; Operating Engineer Rigger; Pneumatic-tired Scraper Operator, up to and including 12 cu. yds. (Turnapull, Euclid, Cat, D.W. Hancock, and similar equipment); Power Jumbo Form Setter Operator; Pressure Grout Machine Operator (as used in heavy engineering construction); Road Oil Mixing Machine Operator; Roller Operator, on all type asphalt pavement; Self-propelled Compactor, with blade; Skip Loader Operator, all types with a rated capacity over 1-1/2 but less than 4 cu. yds.; Slip Form Operator (power driven lifting device for concrete forms); Soil Cement Road Mixing Machine Operator, single pass type; Stationary Central Generating Plant Operator, rated 300 K.W. or more; Surface Heater and Planer Operator; Traveling Pipe-wrapping Machine Operator
- Group 7: Pneumatic-tired Scraper Operator, all sizes and types over 12 cu. yds. MRC (Turnapull, Euclid, Cat, D.W. Hancock and similar equipment); Tractor Operator (Pusher, Bulldozer, Scraper); Trenching Machine Operator
- Group 8: Asphalt or Concrete Planing, Rotomill, and Milling Machine Operator; Auto Grade Machine Operator (CMI and similar equipment); Boring Machine Operator (including Mole, Badger and similar type); Concrete Mixer Operator, paving type and Mobile Mixers; Concrete Pump Operator, with boom attached (truck mounted); Crane Operator, Crawler and Pneumatic type under 100 ton capacity MRC; Crawler-type Tractor Operator, with boom attachment or Slope Bar; Derrick Operator; Forklift Operator for hoisting personnel; Gradall Operator; H. D. Mechanic and/or Welder; Helicopter Hoist Operator; Highline Cableway Operator (less than 20 tons rated capacity); Mass Excavator Operator (150 Bucyrus Erie and similar types); Mechanical Hoist Operator (two or more drums); Motor Grader Operator, any type power blade; Motor Grader Operator, with



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Elevating Grader attachment; Mucking Machine Operator;

Overhead Crane Operator; Piledriver Engineer (portable, stationary or skid rig); Pneumatic-tired Scraper Operator, all sizes and types (Turnapull, Euclid, Cat, D.W. Hancock and similar equipment over 45 cu. yds. MRC); Power driven Ditch Lining or Ditch Trimming Machine Operator; Skip Loader Operator, all types rated capacity 4 cu. yd. but less than 8 cu. yds.; Slip Form Paving Machine Operator (including Gunnert, Zimmerman and similar types); Specialized Power Digger Operator, attached to wheel-type tractor; Tower Crane (or similar type) Operator; Tugger Operator (two or more); Universal Equipment Operator, Shovel, Backhoe, Dragline, Clamshell, etc., up to 8 cu. yds.

Group 9: Crane Operator, Pneumatic or Crawler, 100 ton hoisting capacity and over MRC rating; Helicopter Pilot, FAA qualified, when used in construction work other than executive travel and single casual rental; Highline Cableway Operator, over 20 ton rated capacity and using traveling head and tail tower; Remote-control Earth Moving Equipment Operator; Skip Loader Operator, all types with rated capacity of 8 cu. yds. or more; Universal Equipment Operator, Shovel, Backhoe, Dragline, Clamshell, etc., 8 cu. yds. and over

#### TRUCK DRIVERS

Group 1: Teamsters; Pick-ups; Station Wagon; Man Haul Driver

Group 2: Dump or Flatrack (2 or 3 axle); Water Truck (under 2500 gallons); Buggymobile (1 cu. yd. or less); Bus Driver; Self-propelled Street Sweeper; Shop Greaser

Group 3: Dump or Flatrack (4 axle); Dumptor or Dumpster (less than 7 cu. yds.); Water Truck (2500 gallons but less than 4000 gallons); Tireman

Group 4: Dumptor or Dumpster (7 cu. yds. but less than 16 cu. yds.); Dump or Flatrack (5 axle); Water Truck (4000 gallons and over); Slurry type equipment Driver or Leverman; Vacuum Pump Truck Drivers; Flaherty Spreader or similar type equipment or Leverman; Transit Mix (8 cu. yds. or less mixer capacity); Ambulance Driver

Group 5: Dump or Flatrack (6 axle); Transit Mix (over 8 cu. yds. but less than 10.5 cu. yds.); Rock Truck (i.e. Dart, Euclid and other similar type end dumps, single unit) less than 16 cu. yds.

Group 5A: Oil Tanker or Spreader and/or Bootman, Retortman or Leverman

Group 6: Transit Mix (over 10.5 cu. yds. but less than 14 cu. yds. mixer capacity); Ross Carrier, Fork Lift or Lift Truck; Hydro Lift, Swedish Crane, Iowa 300 and similar types; Concrete Pump (when integral part of transit Mix Truck); Dump



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or Flatrack (7 axle); Transport Driver (unless axle rating results in higher classification)

Group 7: Dump or Flatrack (8 axle)

Group 8: Off-highway equipment Driver including but not limited to: 2 or 4 wheel power unit, i.e. Cat, DW Series, Euclid, International and similar type equipment, transporting material when top loaded or by external means including pulling Water Tanks, Fuel Tanks or other applications under Teamster Classifications; Rock Trucks (Dart, Euclid, or other similar end dump types) 16 cu. yds. and over; Eject-alls; Dumptor or Dumpster (16 cu. yds. and over); Dump or Flatrack (9 axle)

Group 8A: Heavy-duty Mechanic/Welder; Body and Fender Man

Group 8B: Field Equipment Servicemen or Fuel Truck Driver

Group 8C: Body and Fender Man

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR, 5.5 (a)(1)(ii))

**SPECIFICATIONS**

for

**EROSION CONTROL,  
RECREATION AND ESTHETICS**

Arizona Canal Diversion Channel  
and Skunk Creek

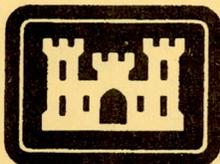
Maricopa County, Arizona

Authority:

Public Law 89-298  
Flood Control Act of 1965

Appropriation:

Construction General  
Contributed Funds, Other



**US Army Corps  
of Engineers**

Los Angeles District

SPECIAL CLAUSES

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| 3. Contract Drawings and Specifications               | 13. As-Built Drawings  |
| 4. Submittals   | 14. Environmental Litigation                                   |
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1. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (1984 APR) FAR 52.212-3. The Contractor shall be required to (a) commence work under this contract within 5 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 300 calendar days after the date of receipt of notice to proceed, except for seeding and planting. Seeding and planting shall be completed as soon as practicable and within the time limits stated in the Technical Provisions or as directed by the Contracting Officer. The time stated for completion shall include final cleanup of the premises.

2. LIQUIDATED DAMAGES-CONSTRUCTION (APR 1984) FAR 52.212-5.

2.1 If the Contractor fails to complete the work within the time specified in the contract, or any extensions, the Contractor shall pay to the Government as liquidated damages, the sum of \$1,970.00 for each day of delay.

2.2 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 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 or accepted.

3. CONTRACT DRAWINGS AND SPECIFICATIONS. (SEP 1987) DFARS 252.236-7002.

3.1 Ten sets of large scale contract drawings and specifications will be furnished the Contractor without charge except applicable publications incorporated into the technical provisions by reference. Additional sets will be furnished on request at the cost of reproduction. One set of reproducible will be furnished the Contractor on a one-time basis in lieu of the above contract drawings at the option of the Contracting Officer. The work shall conform to the specifications and the following contract drawings identified on the following index of drawings:

District File No. 252/380 Rev. D

Index to Contract Drawings

3.2 Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

3.3 The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

#### 4. SUBMITTALS (15 MAY 1984) ER 415-1-10.

4.1 General. Reference is made to the CONTRACT CLAUSE: SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION. The Contractor shall submit for approval all shop drawings, certificates of compliance, equipment data, and/or material samples called for by these specifications.

4.2 Submittal Register. Within 15 days after receipt of notice to proceed, the Contractor shall complete and submit to the Contracting Officer, in duplicate, Submittal Register, ENG FORM 4288, listing all submittals and dates. In addition to these items listed on the register, the Contractor shall furnish submittals for any deviation from the plans or specifications. The scheduled need dates must be recorded on the register for each item for control purposes. In preparing the register, adequate time, a minimum of 30 days, will be allowed for review, approval and possible resubmittal. Scheduling shall be coordinated with the approved progress schedule. The Contractor's Quality Control representative shall review the listing at least every 30 days and take appropriate action to maintain an effective system. Copies of updated or corrected listings shall be submitted to the Contracting Officer at least every 60 days in the quantity specified. Payment will not be made for any material or equipment which does not comply with contract requirements.

4.3 The attached submittal register is a minimum listing of the submittals that the Contractor shall submit to the Contracting Officer. The Contractor shall complete those columns in the submittal register (ENG Form 4288) entitled "NAS Activity Code," "Submittal Identification Number," and "Contractor Schedule Dates." The Contractor shall coordinate the submittal register with the specific detailed requirements of the Technical Provisions of the contract. In the case of conflict between the Submittal Register and the Technical Provisions of this contract, the requirements of the Technical Provisions will govern.

4.4 The listing of submittals in the Submittal Register shall not relieve the Contractor from providing additional submittals required by the Contracting Officer under the Provisions of the CONTRACT CLAUSES.

4.5 Transmittals. The Contractor shall complete ENG FORM 4025, "Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance" with each set of shop drawings, certificates, equipment data or samples submitted. Blank ENG FORM 4025 will be furnished by the Contracting Officer on request. Six (6) copies of each submittal will be required.

4.6 Shop Drawings. The Contractor shall submit to the Contracting Officer for approval ten (10) copies of all shop drawings called for by these specifications. One set will be returned to the Contractor.

4.7 Certificates of Compliance (1969 MAY OCE) EFARS 52.2/9108(c). Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in six (6) 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.

4.8 Resubmittals. If a submittal is returned for correction or is not satisfactory and is disapproved by the Contracting Officer, the Contractor shall resubmit the corrected material, in the same quantity, as specified for the original submittal, for approval within 14 days after receipt of the disapproved material.

5. PHYSICAL DATA (APR 1984) FAR 52.236-4. Data and Information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

5.1 The indications of physical conditions on the drawings and in the specifications are the result of site investigations by surveys.

5.2 Weather Conditions. The Contractor shall satisfy himself as to the hazards likely to arise from weather conditions. Complete weather records and reports may be obtained from any U.S. Weather Bureau Office.

5.3 Transportation Facilities. The Contractor shall make his own investigation of the condition of available public and private roads, railroads, and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the site work. It shall be the Contractor's responsibility to construct and maintain at his own expense, any haul roads required for construction operations.

5.4 Additional Information, including but not necessarily limited to, results of laboratory tests of material encountered in test holes or other explorations and field logs, is available for inspection and study in the office of District Engineer, Geotechnical Branch, 300 North Los Angeles Street, Los Angeles, California.

6. LAYOUT OF WORK (APR 1984) FAR 52.236-17.

6.1 The Contractor shall lay out its work from the Government-established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at its

own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

7. DAMAGE TO WORK (1966 MAR OCE) EFARS 52.2/9109(c) ALT A. The responsibility for damage to any part of the permanent work shall be as set forth in the clause of the contract entitled: PERMITS AND RESPONSIBILITIES. However, if, in the judgment of the Contracting Officer, any part of the permanent work performed by the Contractor is damaged by flood or earthquake, which damage is not due to the failure of the Contractor to take reasonable precautions or to exercise sound engineering and construction practices in the conduct of the work, the Contractor will make the repairs as ordered by the Contracting Officer and full compensation for such repairs will be made at the applicable contract unit or lump sum prices as fixed and established in the contract. If, in the opinion of the Contracting Officer, there are no contract unit or lump sum prices applicable to any part of such work an equitable adjustment pursuant to the clause of the contract entitled: CHANGES, will be made as full compensation for the repairs of that part of the permanent work for which there are no applicable contract unit or lump sum prices. Except as herein provided, damage to all work (including temporary construction), utilities, materials, equipment and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

8. CONTINUING CONTRACTS (1985 JAN HQ USACE) EFARS 52.2/9109(c).

8.1 This is a continuing contract, as authorized by Section 10 of the River and Harbor Act of September 22, 1922 (33 U.S. Code 621). The payment of some portion of the contract price is dependent upon reservations of funds from future appropriations. The responsibilities of the Government are limited by this clause notwithstanding any contrary provision of the: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS clause or any other clause of this contract.

8.2 The sum of \$50,000 has been reserved for this contract and is available for payments to the Contractor during the current fiscal year. It is expected that Congress will make appropriations for future fiscal years from which additional funds will be reserved for this contract.

8.3 Failure to make payments in excess of the amount currently reserved, or that may be reserved from time to time, shall not entitle the Contractor to a price adjustment under the terms of this contract except as specifically provided in paragraphs 8.6, 8.7, 8.8 and 8.9 below. No such failure shall constitute a breach of this contract, except that this provision shall not bar a breach-or-contract action if an amount finally determined to be due as a termination allowance remains unpaid for one year due solely to a failure to reserve sufficient additional funds therefore.

8.4 The Government may at any time reserve additional funds for payments under the contract if there are funds available for such purpose. The Contracting Officer will promptly notify the Contractor in writing of any additional funds reserved for the contract.

8.5 If earnings will be such that funds reserved for the contract will be exhausted before the end of any fiscal year, the Contractor shall give written notice to the Contracting Officer of the estimated date of exhaustion and the amount of additional funds which will be needed to meet payments due or to become due under the contract during that fiscal year. This notice shall be given not less than 45 nor more than 60 days prior to the estimated date of exhaustion.

8.6 No payments will be made after exhaustion of funds except to the extent that additional funds are reserved for the contract. The Contractor shall be entitled to simple interest on any payment that the Contracting Officer determines was actually earned under the terms of the contract and would have been made except for exhaustion of funds. Interest shall be computed from the time such payment would otherwise have been made until actually or constructively made, and shall be at the rate established by the Secretary of the Treasury pursuant to Public Law 92-41, 85 STAT 97, for the Renegotiation Board, as in effect on the first day of the delay in such payment.

8.7 Any suspension, delay, or interruption of work arising from exhaustion or anticipated exhaustion of funds shall not constitute a breach of this contract and shall not entitle the Contractor to any price adjustment under the CONTRACT CLAUSE: SUSPENSION OF WORK or in any other manner under this contract.

8.8 An equitable adjustment in performance time shall be made for any increase in the time required for performance of any part of the work arising from exhaustion of funds or the reasonable anticipation of exhaustion of funds.

8.9 If, upon the expiration of sixty (60) days after the beginning of the fiscal year following an exhaustion of funds, the Government has failed to reserve sufficient additional funds to cover payments otherwise due, the Contractor, by written notice delivered to the Contracting Officer at any time before such additional funds are reserved, may elect to treat his right to proceed with the work as having been terminated. Such a termination shall be considered a termination for the convenience of the Government.

8.10 If at any time it becomes apparent that the funds reserved for any fiscal year are in excess of the funds required to meet all payments due or to become due the Contractor because of work performed and to be performed under the contract during the fiscal year, the Government reserves the right, after notice to the Contractor, to reduce said reservation by the amount of such excess.

9. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE. (1985 JAN HQ USACE) EFARS 52.2/9108(f).

9.1 Allowable cost for construction equipment in sound workable condition owned or controlled and furnished by a Contractor or subcontractor at any tier shall be based on actual cost data when the Government can determine both ownership and operating costs for each piece of equipment or equipment groups of similar serial and series from the Contractor's accounting records. When both ownership and

operating costs cannot be determined from the Contractor's accounting records, equipment costs shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule," Region VII. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

9.2 Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36 substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

9.3 When actual equipment costs are proposed and the total amount of the pricing action is over \$25,000, cost or pricing data shall be submitted on Standard Form 1411, "Contract Pricing Proposal Cover Sheet." By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorizing representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

#### 10. PERFORMANCE OF WORK BY THE CONTRACTOR (1984 APR) FAR 52.236-1.

10.1 The Contractor shall perform on the site, and with its own organization, work equivalent to at least thirty-five (35) percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement of this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

#### 11. PERFORMANCE EVALUATION OF CONTRACTOR (1985 JAN HQ USACE) EFARS 52.2/9006.

11.1 The Contractor's performance will be evaluated upon final acceptance of the work. However, interim evaluation may be prepared at any time during contract performance when determined to be in the best interest of the Government.

11.2 The format for the evaluation will be SF 1420, and the Contractor will be rated either outstanding, satisfactory, or unsatisfactory in the areas of Contractor Quality Control, Timely Performance, Effectiveness of Management, Compliance with Labor Standards, and Compliance with Safety Standards. The Contractor will be advised of any unsatisfactory rating either in an individual element or in the overall rating, prior to completing the evaluation, and all Contractor comments will be made a part of the official record. Performance Evaluation Reports will be available to all DOD Contracting offices for their future use in determining Contractor responsibility, in compliance with DFARS 36.201(C)(1).

12. HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (APR 1984)  
FAR 52.223-3.

12.1 The Contractor agrees to submit a Material Safety Data Sheet (Department of Labor Form OSHA-20), as prescribed in Federal Standard No. 313A, for all hazardous material 5 days before delivery of the material, whether or not listed in Appendix A of the Standard. This obligation applies to all materials delivered under this contract which will involve exposure to hazardous materials or items containing these materials.

12.2 "Hazardous material," as used in this clause is as defined in Federal Standard No. 313A, in effect on the date of this contract.

12.3 Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.

12.4 The Contractor shall comply with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

12.5 The Government's rights in data furnished under this contract with respect to hazardous material are as follows:

12.5.1 To use, duplicate, and disclose any data to which this clause is applicable. The purposes of this right are to (i) apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting, or disposing of hazardous materials; (ii) obtain medical treatment for those affected by the material; and (iii) have others use, duplicate, and disclose the data for the Government for these purposes.

12.5.2 To use, duplicate, and disclose data furnished under this clause, in accordance with subparagraph 11.5.1 above, in precedence over any other clause of this contract providing for rights in data.

12.5.3 That the Government is not precluded from using similar or identical data acquired from other sources.

12.5.4 That the data shall not be duplicated, disclosed, or released outside the Government, in whole or in part for any acquisition of manufacturing purpose, if the following legend is marked on each piece of data to which this clause applies.

"This is furnished under United States Government Contract No. \_\_\_\_\_ and shall not be used, duplicated, or disclosed for any acquisition or manufacturing purpose without the permission of \_\_\_\_\_. This legend shall be marked on any reproduction of this data."

12.5.5 That the Contractor shall not place the legend or any other restrictive legend or any data which (i) the Contractor or any subcontractor previously delivered to the Government without limitations or (ii) should be delivered without limitations under the conditions specified in the Federal Acquisition Regulation in the clause at 52.227-18, Rights in Data.

12.6 The Contractor shall insert this clause, including this paragraph, with appropriate changes in the designation of the parties, in subcontracts at any tier (including purchase designations or purchase orders) under this contract involving hazardous material.

13. AS-BUILT DRAWINGS (ER 415-345-38).

13.1 General. The Contractor shall furnish three (3) full size sets of as-built blue-line prints for use in preparation of as-built drawings by the Government. The as-built prints shall be a record of the construction as installed and completed by the Contractor. They shall include all the information shown on the contract set of drawings and a record of all deviations, modifications, or changes from those drawings, however minor, which were incorporated in the work, all additional work not appearing on the contract drawings, and all changes which are made after final inspection of the contract work. In event the Contractor accomplishes additional work which changes the as-built conditions of the facility after submission of the as-built drawings, the Contractor shall furnish revised and/or additional drawings as required to depict as-built conditions. The requirements for these additional drawings will be the same as for the as-built drawings included in the original submission. The prints shall show the following information, but not be limited thereto:

13.1.1 The location and description of any utility lines or other installations of any kind or description known to exist within the construction area. The location includes dimensions to permanent features.

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

13.1.3 Correct grade or alignment of roads, structures or utilities if any changes were made from contract plans.

13.1.4 Correct elevations if changes were made in site grading.

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

13.1.6 The topography and grades of all drainage installed or affected as a part of the project construction.

13.1.7 All changes or modifications which result from the final inspection.

13.1.8 Additive Items. Where contract drawings or specifications provide additive items, the items selected for construction shall be shown on the as-built drawings.

13.1.9 Submittal to Contracting Officer for review and approval. Not later than 2 weeks after acceptance of the project by the Government, the Contractor shall deliver to the Contracting Officer three (3) full size sets of blue-line

prints marked up to depict as-built conditions. If upon review, the drawings are found to contain errors and/or omissions, they shall be returned to the Contractor for corrections. The Contractor shall complete the corrections and return the drawings to the Contracting Officer within ten (10) calendar days.

13.1.10 Preliminary As-Built Prints. The Contractor shall maintain one set of paper prints to show the as-built conditions. These as-built marked prints shall be kept current and available on the jobsite at all times. All changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. The as-built marked prints will be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the construction Contractor prior to submission of each monthly pay estimate. Information to be included on the preliminary prints shall conform to the requirements of final as-built prints.

#### 14. ENVIRONMENTAL LITIGATION (1974 NOV OCE) EFARS 52.2/9109(i).

14.1 If the performance of all or part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation, as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the CONTRACT CLAUSE: SUSPENSION OF WORK. The period of such suspension, delay or interruption shall be considered unreasonable, and an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) as provided in that clause, subject to all the provisions thereof.

14.2 The term "environmental litigation", as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect of the work on the environment.

15. NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE (MAY 1986) FAR 52.212-7. Any contract awarded as a result of this solicitation will be assigned a DO rated order certified for national defense use under the Defense Priorities and Allocations System (DPAS) (15CFR 350), and the Contractor will be required to follow all of the requirements of this regulation.

#### 16. OPERATION AND MAINTENANCE MANUALS AND INSTRUCTIONS.

16.1 The requirements for furnishing operating and maintenance data/manuals and field instructions under this contract are specified in the Technical Provisions. The Contractor shall submit to the Contracting Officer, not later than 45 calendar days prior to the project completion time, an outline showing the proposed submittal date(s) of operation and maintenance manuals to be furnished to the Government and the scheduled date(s) of all required field instructions to be provided by Contractor furnished personnel or manufacturer's representatives.

All operation and maintenance manuals must be furnished to the Contracting Officer not later than 30 calendar days prior to project completion if no Contractor furnished field instructions are required.

16.2 Failure on the part of the Contractor to comply with requirements of this clause will result in the Government withholding an estimated amount for obtaining replacement (substituted) manuals from a different source or until all required O&M data/manuals are submitted and accepted.

16.3 All O&M data/manuals submittal data shall be entered in a separate section of the master submittal register.

17. TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (DAEN-ECC-Q LTR 3 APR 84).

17.1 This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the CONTRACT CLAUSE: DEFAULT. The listing below defines the monthly anticipated adverse weather for the contract period and is based upon NOAA or similar data for the geographical location of the project.

MONTHLY ANTICIPATED ADVERSE WEATHER CALENDAR DAYS

ELEMENT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Precipitn .10"	2	2	2	1	0	0	2	3	2	2	1	2	19
Temp 32 °F	8	5	1	0	0	0	0	0	0	0	2	6	22
Total days*	10	7	3	1	0	0	2	3	2	2	3	8	41

\*Total number of adverse weather days per month (anticipated average) is based upon precipitation .10 inch, and temperature 32 degrees F. The concurrence factor is approximately 10 percent between precipitation and temperature during January and 5 percent during November, December, February, and March.

Winds 40-50 mph are relatively uncommon, although wind gusts associated with summer thunderstorms can exceed 45 mph on relatively rare occasions.

17.2 Determination.

17.2.1 The above schedule of anticipated adverse weather will constitute the base line for monthly, or portion thereof, weather time evaluations. Upon acknowledgment of the notice to proceed and continuing throughout the contract on a monthly basis, actual adverse weather days will be recorded on a calendar day basis, including weekends and holidays, and compared to the monthly anticipated adverse weather in subparagraph 17.1 above. For purposes of subparagraph 17.2, the term actual adverse weather days shall include days impacted by actual adverse weather days.

17.2.2 The number of actual adverse weather days shall be calculated chronologically from the first to the last day in each month. Once the number of actual adverse weather days anticipated in subparagraph 17.1 above have been incurred, the Contracting Officer will examine any subsequently occurring adverse weather days to determine whether a Contractor is entitled to a time extension.

These subsequently occurring adverse weather days must prevent work for 50 percent or more of the Contractor's work day and delay work critical to the timely completion of the project. The Contracting Office will convert any delays to meeting the above requirements to calendar days and issue a modification in accordance with the CONTRACT CLAUSE: DEFAULT.

17.3 The Contractor's schedule must reflect the above anticipated adverse weather delays on all weather dependent activities.

\* \* \* \* \*

SUBMITTAL REGISTER		(EN 415-1-10)		TITLE AND LOCATION							Erosion Control, Recreation and Esthetics, ACDC and Skunk Ck. Arizona						
				CONTRACTOR							CONTRACT NUMBER						
NAS ACTIVITY CODE	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL						ACTION ELEMENT	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS	
				SHOP DRAWING	SAMPLE	GUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT		OTHER, AS NOTED	*TECH REVIEW BY	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY		SUBMITTED TO CORPS
		SECTION 1D,	ENVIRONMENTAL PROTECTION														
		3.	Environmental Protection Plan							X	RE						
		SECTION 2A,	DIVERSION AND CONTROL OF WATER														
		1.1	Plans for Diversion or Control of Water								X	RE					
		SECTION 2C,	EXCAVATION, FILLING & BACKFILL FOR STRUCTURES														
		7.	Moisture Density							X	RE						
		7.	Field Density							X	RE						
		SECTION 2D,	EXCAVATION, TRENCHING, AND BACKFILL FOR UTILITIES SYSTEMS														
		3.2	Moisture Density							X	RE						
		7.1	Field In-Place Density							X	RE						
		SECTION 2E,	SIDE DRAIN														
		3.	Installation Procedure					X			RE						
		4.	Pipes						X		RE						
		12.	Moisture Density of Backfill Materials							X	RE						
		12.	Field Density of Backfill Materials							X	RE						

\*AE Architect Engineer

ED-Engineering Division

CD Construction Division

AREA Area Engineer

RE Resident Engineer

HAB ACTIVITY CODE  I J	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							ACTION ELEMENT  *TECH REVIEW BY	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS
				SHOP DRAWING	SAMPLE	QUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT	OTHER AS NOTED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	SUBMITTED TO CORPS	ACTION CODE	
		SECTION 2F,	SANITARY SEWERS														
		3.	Cement for Concrete Pipe														
			Fittings and Precast Manhole						X								
		11.3	Leakage Test of Sewerline							X							
		11.4	Deflection Test of Sewerline							X							
		SECTION 2G,	WATER LINES														
		6.1	Pressure Tests							X							
		6.2	Leakage Tests							X							
		SECTION 2H,	AGGREGATE BASE COURSE														
		3.1	Aggregate From Source			X											
		3.1	Density Test After Compaction			X											
		3.4	Approval of Materials							X	X						
		SECTION 2I,	PRIME COAT AND WEED KILLER														
		3.1	Bituminous Materials			X											
		3.3	Bituminous Materials							X							
		4.	Application of Prime Coat							X							
		7.	Surface Preparation							X							

\*AE Architect Engineer ED-Engineering Division CD-Construction Division AREA-Area Engineer RE-Resident Engineer

SUBMITTAL REGISTER

(ER 415-1-10)

TITLE AND LOCATION  
CONTRACTOR

Erosion Control, Recreation and Esthetics, ACDC and Skunk Ck., Arizona

CONTRACT NUMBER

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				SHOP DRAWING	SAMPLE	GUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT	OTHER, AS NOTED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	SUBMITTED TO CORPS	ACTION CODE		
		SECTION 2J,	ASPHALT CONCRETE															
		5.	Bituminous Materials		X				X									
		7.	Composition of Mixture		X				X									
		SECTION 2K,	CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION															
		3.2	Concrete Delivery Ticket						X									
		14.2.1	Concrete Strength Test							X								
		14.2.3	Concrete Slump Test							X								
		SECTION 2L,	STONE PROTECTION															
		2.	Stone Source		X					X								
		2.3	Stone Service Records								X							
		2.5	Gradation Test							X								
		SECTION 2M,	GROUTING STONE PROTECTION															
		6.	Test Panel							X								
		SECTION 2N,	DESERT GRAVEL SURFACE															
		3.	Desert Gravel		X					X								
		SECTION 2O,	PLAYING SURFACES FOR OUTDOOR SPORTS FACILITIES															
		4.	Tests for Surface Smoothness							X								

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SUBMITTAL REGISTER		(ER 415-1-10)		TITLE AND LOCATION Erosion Control, Recreation and Esthetics, ACDC and Skunk Ck., Arizona							CONTRACT NUMBER							
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				SHOP DRAWING	SAMPLE	GUARANTEE	WPS DATA	CERTIFICATE	TEST REPORT	OTHER, AS NOTED		SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	SUBMITTED TO CORPS	ACTION CODE		
		SECTION 2P,	SEEDING															
		2.	Topsoil and Soil Amendments		X			X										
		9.	Construction Quality Control						X	X								
		SECTION 2Q,	CACTI, TREES, SHRUBS, GROUND COVERS, VINES AND NATIVE ROCK															
		3.	Plant Materials		X		X											
		SECTION 2R,	IRRIGATION															
		7.	Test Piping System						X									
		12.	All Parts of Piping System				X	X										
		SECTION 2T,	CONCRETE INTERLOCKING PAVING STONE															
		3.	Paving Units		X			X	X									
		SECTION 3A,	CONCRETE															
		4.11	Colored Concrete Panel					X	X									
		5.	Concrete Quality						X									
		SECTION 4A,	REINFORCED MASONRY															
		2.	Testing Agency							X								
		4.1	Anchors and Ties		X													
		4.1 & 4.2	Concrete Masonry Units		X			X										
		4.1 & 4.2	Joint Reinforcement		X													

\*AE-Architect Engineer

ED-Engineering Division

CD-Construction Division

AREA-Area Engineer

RE-Resident Engineer





SUBMITTAL REGISTER		(BR 415-1-10)		TITLE AND LOCATION							Erosion Control, Recreation and Esthetics, ACDC and Skunk Ck., Arizona							
				CONTRACTOR							CONTRACT NUMBER							
NAS ACTIVITY CODE	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL							ACTION ELEMENT	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS	
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		SECTION 8B,	HARDWARE, BUILDER'S (GENERAL PURPOSE)															
		4.1	Certificates of Compliance					X										
		4.2	Hardware Schedule							X								
		SECTION 9A,	PAINTING															
		4.1	Certificates of Compliance for															
			Metal Primers					X										
		4.2	Instruction of Application			X												
		SECTION 9B,	STUCCO															
		2.1	Stucco Panel	X														
		2.2	Shop Drawings	X														
		SECTION 10A,	TOILET PARTITIONS															
		3.	Shop Drawings	X														
		SECTION 10B,	TOILET ACCESSORIES															
		3.	Sample and Description data	X		X												
		SECTION 10C,	MISCELLANEOUS ITEMS OF WORK															
		2.	Shop Drawings indicating type,															
			Dimensions, Construction and															
			Installation details	X		X												

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ED Engineering Division

CD Construction Division

AREA Area Engineer

RE Resident Engineer

SUBMITTAL REGISTER		(ER 415-1-10)		TITLE AND LOCATION					Erosion Control, Recreation and Esthetics, ACDC and Skunk Ck., Arizona					CONTRACTOR		CONTRACT NUMBER	
NAB ACTIVITY CODE	SUBMITTAL IDENTIFICATION (ITSM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL						ACTION ELEMENT	CONTRACTOR SCHEDULED DATES			CORPS ACTION DATES		REMARKS	
				SHOP DRAWING	SAMPLE	GUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT		OTHER, AS NOTED	*TECH REVIEW BY	SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY		SUBMITTED TO CORPS
		SECTION 13A,	SPACE FRAMES														
		3.1	Mill Test of Structural Steel					X		RE							
		3.1	Qualification of Welder					X		RE							
		3.2	All Shop & Erection Details	X						RE							
		6.	Description Data		X					RE							
		8.	Structural Calculations						X	RE							
		SECTION 15A,	PLUMBING, GENERAL PURPOSE														
		3.	Plumbing System	X						RE							
		15.4	Operation Test						X	RE							
		SECTION 16A,	ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND														
		3.1	Materials or Equipment				X	X		RE							
		3.2	Weatherproof Pedestal with														
			Meter Sockets	X						RE							
		3.2	Lighting Poles	X						RE							
		3.2	Area-Lighting Luminaires and														
			Mounting Brackets	X						RE							
		3.4	Instruction Manuals of Spare														
			Parts and all Equipment				X			RE							

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		3.5	Factory Test Reports					X											
		3.6.1	Qualifications of Medium-																
			Voltage Cable Installers					X											
		3.6.1	Other Proof of Compliance					X											
		3.6.2	Field Test Report					X											
		3.7	Supplemental Contact Drawings	X															
		14.	Operation Test						X										
		SECTION 16B,	ELECTRICAL WORK, INTERIOR																
		3.3	Materials and Equipment	X			X	X											
		15.	Operation Tests						X										

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2B	Clearing Site and Removing Obstructions
2C	Excavation, Filling, and Backfilling for Structures
2D	Excavation, Trenching, and Backfilling for Utilities Systems
2E	Side Drains
2F	Sanitary Sewers
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2I	Prime Coat and Weed Killer
2J	Asphalt Concrete
2K	Concrete Sidewalks, Curbs and Gutters, and Slope Protection
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2O	Playing Surfaces for Outdoor Sports Facilities
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SECTION 1A

GENERAL REQUIREMENTS

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| 7. Scrap Materials                                |   |
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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 Specifications (Fed. Spec.).

FF-B-575C	Bolts, Hexagon and Square
FF-N-105B & Am-3	Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
FF-N-836D & Am-1	Nut: Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat
MM-L-751H	Lumber; Softwood
TT-E-529D	Enamel, Alkyd, Semi-Gloss
TT-P-25E & Am-2	Primer Coating, Exterior (Undercoat for Wood, Ready-Mixed, White and Tints)

1.2 U.S. Department of Commerce National Bureau of Standards, Product Standard (Prod. Std).

PS 1-74	Construction and Industrial Plywood
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2. PROJECT FACILITIES. The Contractor shall construct and/or erect the following project facilities.

2.1 Construction Signs. The signs shall be erected as soon as possible and within 15 days after commencement of work under this contract.

2.1.1 Eleven Project Signs at locations designated by the Contracting Officer.

2.1.2 Warning Signs facing approaching traffic on all haul roads crossing under overhead power transmission lines.

2.1.3 Six hard hat signs at locations directed.

2.2 Bulletin Board at the Contractor's office.

2.3 Sanitary Facilities.

3. CONSTRUCTION SIGNS.

3.1 Materials.

3.1.1 Lumber shall conform to Fed. Spec. MM-L-751, and shall be seasoned Douglas Fir, S4S, Grade D or better except that posts, braces and spacers shall be construction Grade (WCLB).

3.1.2 Plywood shall conform to Prod. Std. PS 1, grade A-C, Group 1, exterior type.

3.1.3 Bolts, Nuts and Nails. Bolts shall conform to Fed. Spec. FF-B-575, nuts shall conform to Fed. Spec. FF-N-836, and nails shall conform to Fed. Spec. FF-N-105.

3.1.4 Paints and Oils. Paints shall conform to Fed. Spec. TT-P-25 for primer and TT-E-529 for finish paint and lettering.

3.2 Construction.

3.2.1 Project and hard hat signs shall be constructed as detailed on Figures 1, 2 and 3. Decals and safety signs will be furnished by the Contracting Officer.

3.2.2 Warning Signs shall be constructed of plywood not less than 1/2 inch thick and shall be securely bolted to the supports with the bottom of the sign face 3 feet above the ground. The sign face shall be 2 x 4 feet, all letters shall be 4 inches in height, and the wording shall be: "WARNING: OVERHEAD TRANSMISSION LINES."

3.3 Painting. All exposed surfaces and edges of plywood shall be given one coat of linseed oil and be wiped prior to applying primer. All exposed surfaces of signs and supports shall be given one coat of primer and 2 finish coats of white paint. Except as otherwise indicated, lettering on all signs shall be black and sized as indicated.

4. PROJECT ENGINEER'S OFFICE.

4.1 General. The Contractor shall provide a suitable office trailer or building for the Project Engineer. The exact site will require the Contracting Officer's approval. Both the trailer and building shall be adequately heated, well lighted, suitably ventilated, and cooled with an exterior mounted, air conditioner, complete, with all piping and electrical connections. An adequate supply of cooled drinking water shall be furnished and maintained. Open parking space for 6 vehicles and water and sanitary facilities shall be located convenient to the office. The combined parking and building area shall be enclosed with a woven wire fence approximately 6 feet high with a 10-foot wide lockable gate accessible from a road or street. The fenced area shall be of sufficient size to permit ease in the parking of vehicles. Materials for the facilities need not be new provided they are adequate for the intended use. Office is to be installed within 10 days of issue of Notice to Proceed and is not to be removed before completion of the job.

4.2 Office Trailer shall be approximately 10 feet wide by 40 feet in length.

4.3 Flagpole. The Contractor shall furnish and erect a flagpole at the Project Engineer's Office. The flagpole shall be either wood or sectional steel type, a product of a reputable manufacturer who has been regularly engaged in the manufacture of flagpoles. The flagpole shall be complete with standard fittings and equipment, including pulley, cleats, ground protector, halyards, and snap hooks. The pole shall have 20 feet exposed height and be set in concrete foundation in conformance with the manufacturer's recommendations. Painting of the wooden pole shall conform to the applicable requirements for the project sign. Steel shall be galvanized.

5. BULLETIN BOARD. A weatherproof bulletin board, approximately 36 inches wide and 30 inches high, with hinged glass door shall be provided adjacent to or mounted on the Contractor's project office. If adjacent to the office, the bulletin board shall be securely mounted on no less than 2 posts. Bulletin board and posts shall be painted or have other approved factory finish. The bulletin board shall be easily accessible at all times and shall contain wage rates, equal opportunity notice, and such other items required to be posted.

6. MAINTENANCE AND DISPOSAL OF PROJECT FACILITIES. The Contractor shall maintain the project facilities in good condition throughout the life of the project. Upon completion of work under this contract, the facilities covered under this section will remain the property of the Contractor and shall be removed from the site at his expense.

7. SCRAP MATERIAL. Materials indicated to be removed and not indicated to be salvaged, stored or reinstalled are designated as scrap and shall become the property of the Contractor and be removed from the site of work. The Contractor by signing this contract hereby acknowledges that he made due allowance for value, if any, of such scrap in the contract price.

8. SALVAGE MATERIALS. All materials and/or equipment removed and indicated to be either stored or reinstalled are designated as salvaged materials and/or equipment. Any salvaged materials and equipment which are excess upon completion of the work and are not indicated to be stored shall become the property of the Contractor.

9. ARCHAEOLOGICAL FINDINGS DURING CONSTRUCTION. Should the Contractor or any of his employees in the performance of this contract find or uncover any archaeological remains, he shall stop work and notify the Project Engineer immediately. Such notifications will be a brief statement in writing giving the location and nature of the findings. Should the discovery site require archaeological studies resulting in delays and/or additional work, the Contractor will be compensated by an equitable adjustment in accordance with CONTRACT CLAUSES.

10. PUBLIC UTILITIES, NOTICES, AND RESTRICTIONS.

10.1 General. The approximate location of all railroads, pipe lines, power and communication lines, and other utilities known to exist within the limits of the work are indicated on the drawings. The sizes, locations, and names of owners of such utilities are given from available information, but their accuracy is not guaranteed. Except as otherwise indicated on the drawings, all existing utilities will be left in place and the Contractor shall conduct his operations in such a

manner that the utilities will be protected from damage at all times, or arrangements shall be made by the Contractor for their relocation at the Contractor's own expense. The Contractor shall be responsible for any damage to utilities known to exist and shall reimburse the owners for such damage as is caused by his operations.

10.2 Relocation or Removal. Utilities to be relocated or removed not as part of this contract are designated "To be Relocated by Others" or "To be Removed by Others," respectively. Utilities shown on the plans and not so designated will be left in place and be subject to CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS. The Contractor may make arrangements with the owner for the temporary relocation and restoration of utilities not designated to be relocated, or for additional work in excess of the work needed to relocate utilities designated for relocation at no additional cost to the Government.

10.3 Utilities Not Shown. If the Contractor encounters, within the construction limits of the entire project, utilities not shown on the plans and not visible as of the date of this contract and if such utilities will interfere with construction operations, he shall immediately notify the Contracting Officer in writing to enable a determination by the Contracting Officer as to the necessity for removal or relocation. If such utilities are left in place, removed or relocated, as directed by the Contracting Officer, the Contractor shall be entitled to an equitable adjustment for any additional work or delay.

10.4 Coordination. The Contractor shall consult and cooperate with the owner of utilities that are to be relocated or removed by others to establish a mutual performance schedule and to enable coordination of such work with the construction work. These consultations shall be held as soon as possible after award of the contract or sufficiently in advance of anticipated interference with construction operations to provide required time for the removal or relocation of affected utilities.

10.4.1 The Contractor shall notify the Contracting Officer, in writing, 14 calendar days prior to starting work on any utility to be relocated or protected. On each relocation, notification shall include dates on which the Contractor plans excavation, by-pass work, removal work and/or installation work, as applicable. The Contractor shall also notify the following representatives of utility owners not less than 14 days prior to start of work in the vicinity of their respective utilities.

Flood Control District of Maricopa County  
3335 West Durango Street  
Phoenix, Arizona 85009  
Mr. R. W. Shobe  
Telephone: (602) 262-1501

Arizona Public Service  
Metro Engineering Service  
P.O. Box 21666  
2121 W. Cheryl Drive  
Phoenix, Arizona 85036  
Mr. Ernest Cota  
Telephone: (602) 271-3576

City of Peoria  
P.O. Box 38  
Peoria, Arizona 85345  
Mr. Eldon Johansen  
Telephone: (602) 974-6121

Salt River Project  
Civil Engineering Dept.  
P.O. Box 1980  
Phoenix, Arizona 85001  
Mr. Robert Larchick  
Telephone: (602) 236-5373

Mountain Bell Telephone Company  
3033 North 3rd Street  
Phoenix, Arizona 85012  
Mr. Alan Meins  
Telephone: (602) 235-3155

City of Glendale  
5850 W. Glendale  
Glendale, Arizona 85301  
Mr. Ken Reedy  
Telephone: (602) 435-4152

Southwest Gas Corp.  
P.O. Box 52075  
2820 Kelton Lane  
Phoenix, Arizona 85072-2075  
Mr. Eugene Florez  
Telephone: (602) 866-4264

10.4.2 Staking of Utilities. In addition to notification of representatives of utility owners, the Contractor shall notify the Blue Stakes Center, phone (602) 263-1100, two working days prior to any excavation within any street right-of-way or any work in the vicinity of known underground utilities, to have underground utilities field located and staked.

10.4.3 The Salt River Project has indicated that it will make available water for construction under this contract. Information regarding conditions of availability can be obtained by contacting Mr. Charlie Ester, Salt River Project, at (602) 236-2587.

#### 10.5 Notices

10.5.1 Traffic Routing. The Contractor shall notify the Contracting Officer 7 days in advance of the time work will be started in areas requiring the rerouting of traffic, traffic lane striping, and removal of street signs. Traffic control shall conform to the Traffic Barricade Manual, City of Phoenix and Part 400 of the Uniform Standard Specifications for Public Works Construction, Maricopa Association of Governments, Arizona. The foregoing shall apply to progressive modifications of traffic routings within an area in which work is in progress.

10.5.2 Police, Highway Patrol, and Fire Departments shall be notified by the Contractor whenever a street is to be closed to traffic. If the closing is to be of long duration, a single notification to each department on the last working day before closing will be sufficient. A single notification shall then be made at the time the street is again opened to traffic. If the closing is to be of short duration or if different sections of the street are to be closed at different times, notifications shall be made on a day-to-day basis.

10.5.3 Utilities To be Relocated or Protected. The Contractor shall notify the Contracting Officer, in writing, 14 calendar days prior to starting work on any utility to be relocated or protected. On each relocation, notification shall include dates on which the Contractor plans excavation, by-pass work, removal work and/or installation work, as applicable.

10.5.4 The Contractor shall notify the Contracting Officer, in writing, not less than 14 days in advance of the date on which he will complete trenching, excavation, fill or rough grading, as applicable, at each location where such completed work is required for temporary or permanent relocations by others. The Contractor shall allow a period of 14 calendar days at each relocation, after which time the Contractor may resume his operations.

10.5.5 Existing Bench Marks and R/W Markers. The Contractor shall notify the Contracting Officer, in writing, 7 days in advance of the time he proposes to remove any bench mark or right-of-way marker.

10.5.6 Work in the area between the channel right-of-way and the construction easements shown on the drawings shall be subject to the following restrictions.

10.5.6.1 The Contractor shall removal all excess construction materials placed in this area under this contract after completion of construction.

10.5.6.2 Salt River Project Area. Located on North side of the project.

10.5.6.2.1 Free access to the area by the Salt River Project shall be maintained at all times.

10.5.6.2.2 The area shall only be used by the Contractor for conveyance of construction equipment and for temporary parking of construction equipment, except for construction modification of the wasteway structure.

10.5.6.3 Dust control shall conform to SECTION: ENVIRONMENTAL PROTECTECTION.

10.5.6.4 Permanent features in the area shall be protected in accordance with the CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS.

10.6 Restrictions.

10.6.1 Representatives of Other Agencies. Personnel representing owners and agencies may be present for various portions of the work. However, the Contractor will be responsible only to the Contracting Officer.

10.6.2 The Contractor shall not cross existing paved roadways with construction equipment except at approved marked crossings. Crossings shall be maintained in accordance with applicable state, county, and city regulations.

10.6.3 The Contractor's ingress and egress from the job site shall be restricted to the following main thoroughfares: 83rd Ave., 75th Ave., 67th Ave., Greenway Road, Thunderbird Road, 59th Ave., and Cactus Road.

10.6.4 Working Hours. Construction activities will not be allowed between the hours of 6:00 p.m. and 7:00 a.m.

11. PUBLIC SAFETY. Attention is invited to the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. The Contractor shall provide temporary fencing, barricades, and/or guards as required to provide protection in the interest of public safety. As a minimum this will include a 6-foot chain link fence which completely encloses Thunderbird Paseo; 59th Avenue and Thunderbird Road Plaza; 67th Avenue Plaza; and the Desert Interpretive Garden. Materials for the fence may be new or used provided they are suitable for the intended purposes. Whenever the Contractor's operations create a condition hazardous to the public, he shall furnish at his own expense and without cost to the Government, such flagmen and guards as are necessary to give adequate warning to the public of any dangerous conditions to be encountered and he shall furnish, erect, or maintain such fences, barricades, lights, signs and other devices as are necessary to prevent accidents and avoid

damage or injury to the public. Flagmen and guards, while on duty and assigned to give warning and safety devices shall conform to applicable city, county, and state requirements. Should the Contractor appear to be neglectful or negligent in furnishing adequate warning and protection measures, the Contracting Officer may direct attention to the existence of a hazard and the necessary warning and protective measures shall be furnished and installed by the Contractor without additional cost to the Government. Should the Contracting Officer point out the inadequacy of warning and protective measures, such action of the Contracting Officer shall not relieve the Contractor from any responsibility for public safety or abrogate his obligation to furnish and pay for those devices. The installation of any general illumination shall not relieve the Contractor of his responsibility for furnishing and maintaining any protective facility.

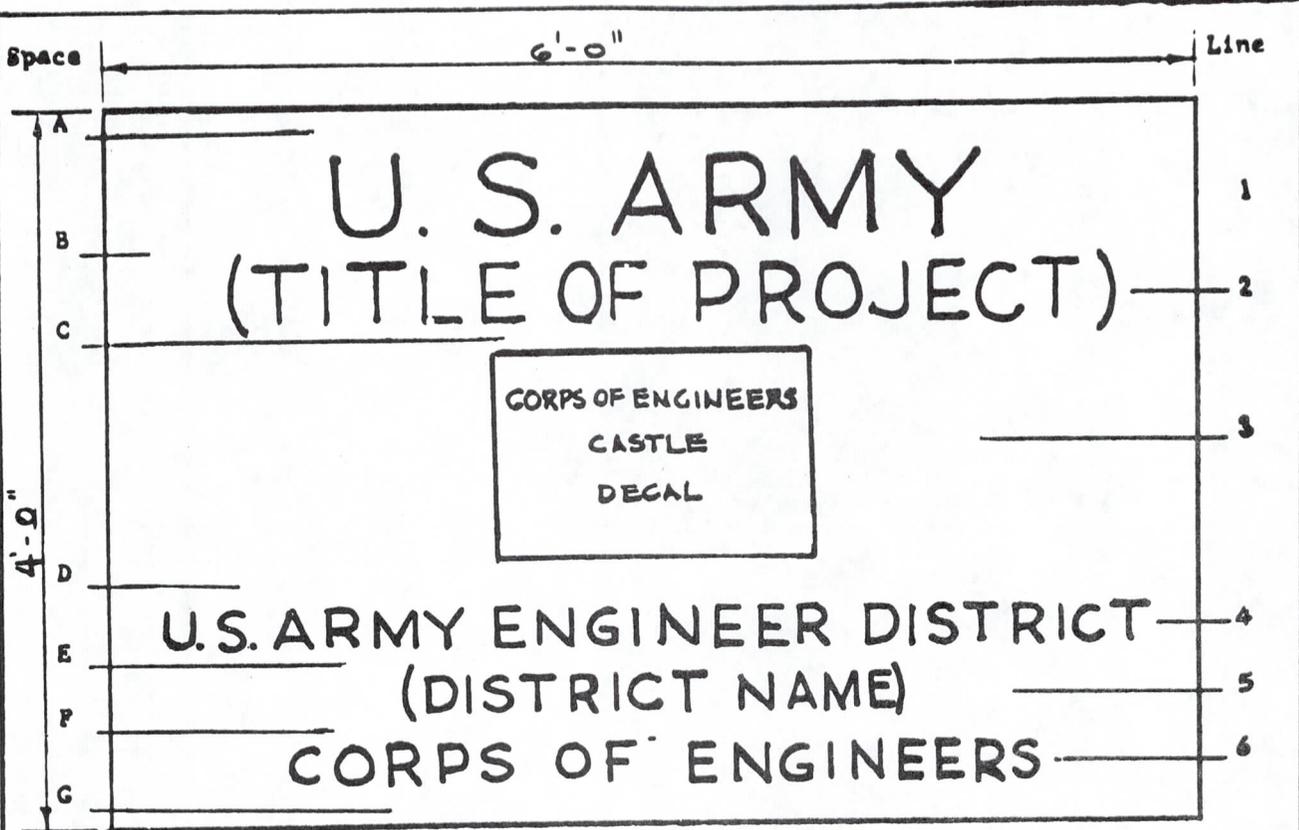
12. OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA) STANDARDS. The OCCUPATIONAL SAFETY and HEALTH ACT (OSHA) STANDARDS for CONSTRUCTION (Title 29, Code of Federal Regulations Part 1926 as revised from time to time) and the Corps of Engineers' General Safety and Health Requirements Manual, EM 385-1-1, are both applicable to this contract. The most stringent requirement of the two standards will be applicable.

13. PERMITS. Reference is made to the CONTRACT CLAUSE: Permits and Responsibilities, which obligates the Contractor to obtain all required licenses and permits.

13.1 Air Pollution Permit. The Contractor will be required to obtain an air pollution control permit. The permit may be obtained from Maricopa County Bureau of Air Pollution Control, telephone (602) 258-6381, extension 372. The permit is expected to cost \$1,530.00.

14. REQUIRED INSURANCE. The Contractor shall provide and maintain during the entire period of his performance under this contract insurance coverage. The Cities of Glendale and Peoria and the Flood Control District of Maricopa County shall be named as additionally insured.

\* \* \* \* \*



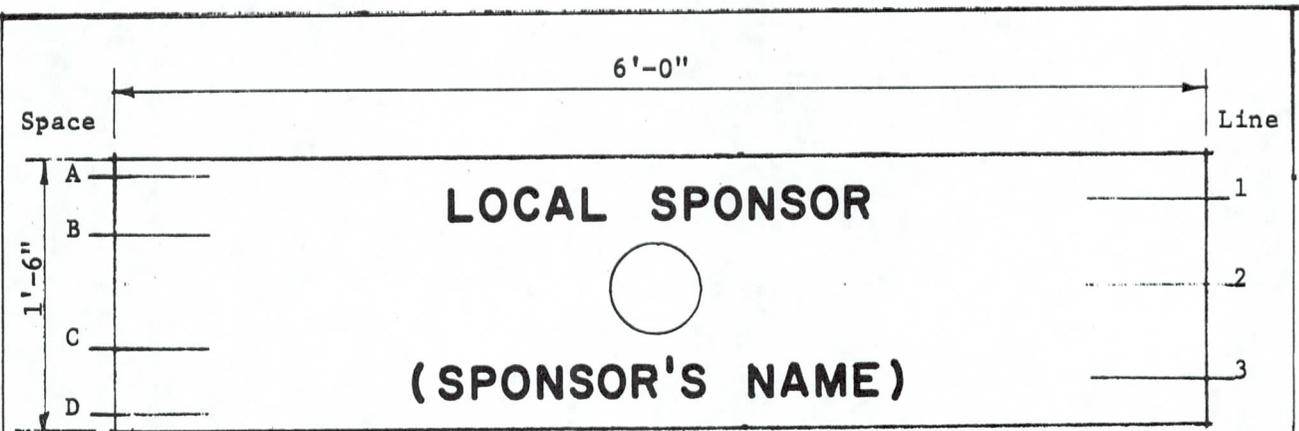
SCHEDULE

<u>Space</u>	<u>Height</u>	<u>Line</u>	<u>Description</u>	<u>Letter Height</u>	<u>Stroke</u>
A	3"	1	U. S. ARMY	5 1/2"	7/8"
B	2"	2	PROJECT NOMENCLATURE	4"	5/8"
C	2"	3	CORPS OF ENGINEERS CASTLE (DECAL)	1 1/4"	--
D	3"	4	U. S. ARMY ENGINEER DISTRICT	2 3/4"	3/8"
E	2"	5	DISTRICT NAME	2 1/4"	1/4"
F	2"	6	CORPS OF ENGINEERS	2 1/2"	3/8"
G	3"				

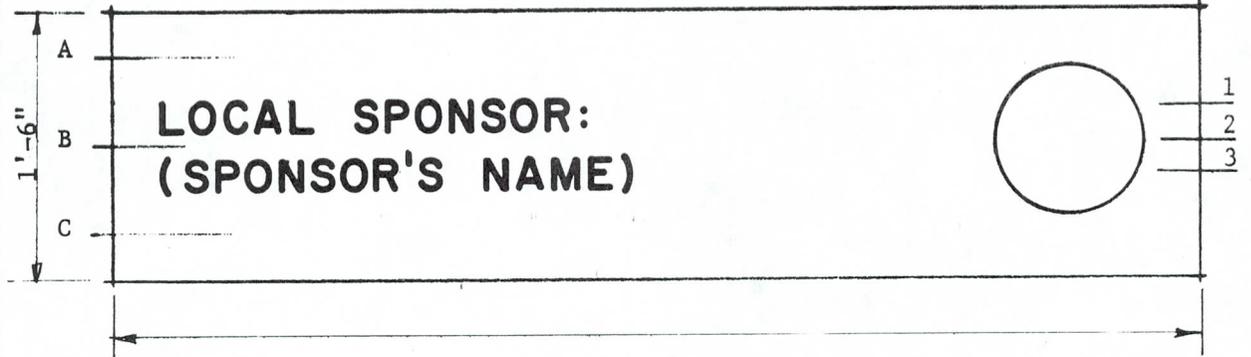
Lettering Color -- Black

PROJECT SIGN  
(Army-Civil Works)

Figure 1  
14 August 1972



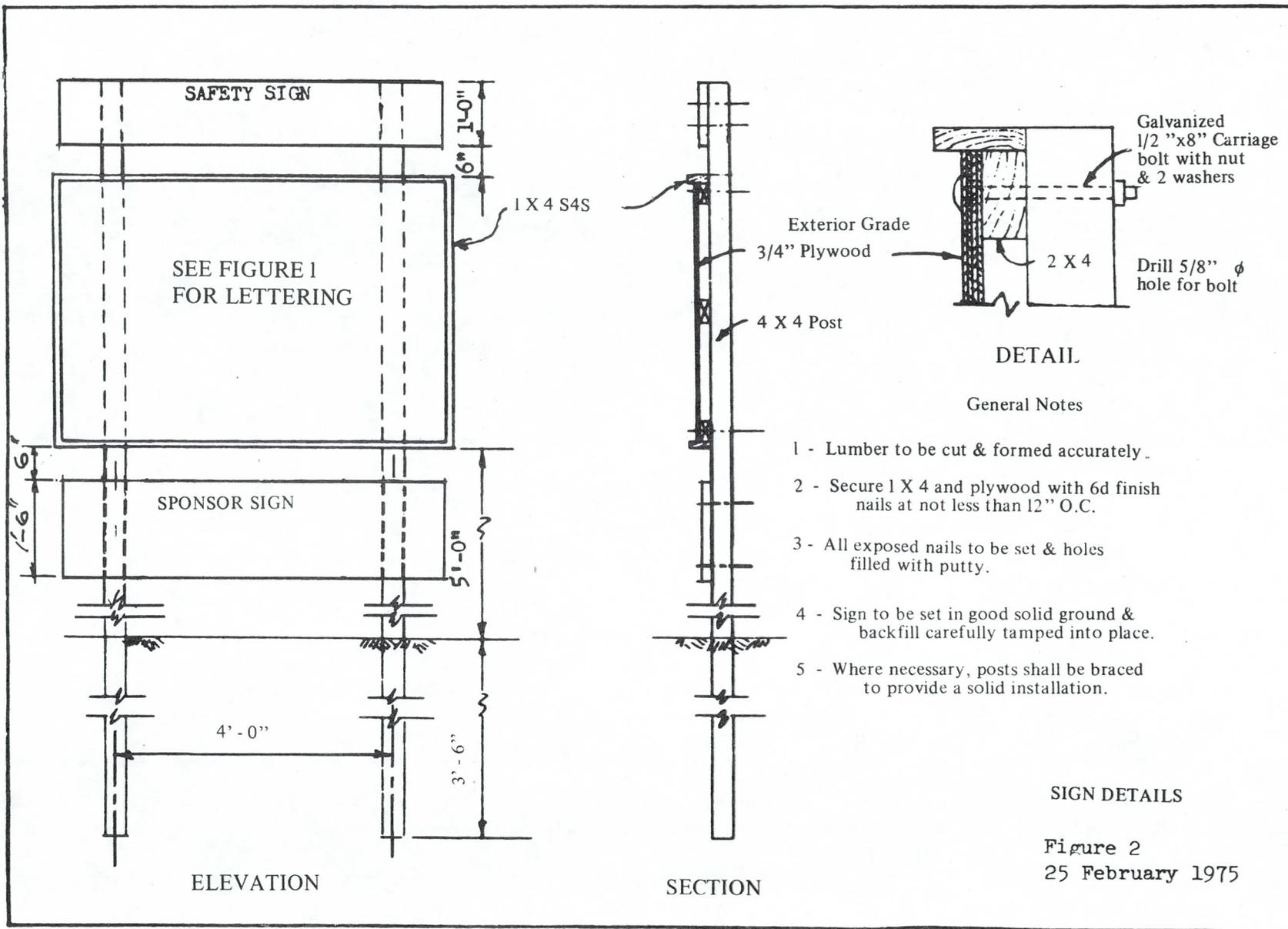
<u>Space</u>	<u>Height</u>	<u>Line</u>	<u>Description</u>	<u>Letter Height</u>	<u>Stroke</u>
A	2"	1	LOCAL SPONSOR	2"	3/8"
B	2" Min.	2	SPONSOR'S EMBLEM (DECAL)		
C	2" Min.	3	SPONSOR'S NAME	2"	3/8"
D	2"				



<u>Space</u>	<u>Height</u>	<u>Line</u>	<u>Description</u>	<u>Letter Height</u>	<u>Stroke</u>
A	6"	1	LOCAL SPONSOR	2"	3/8"
B	2"	2	SPONSOR'S EMBLEM (DECAL)		
C	6"	3	SPONSOR'S NAME	2"	3/8"

Lettering Color -- Black

Figure 1A  
21 February 1975



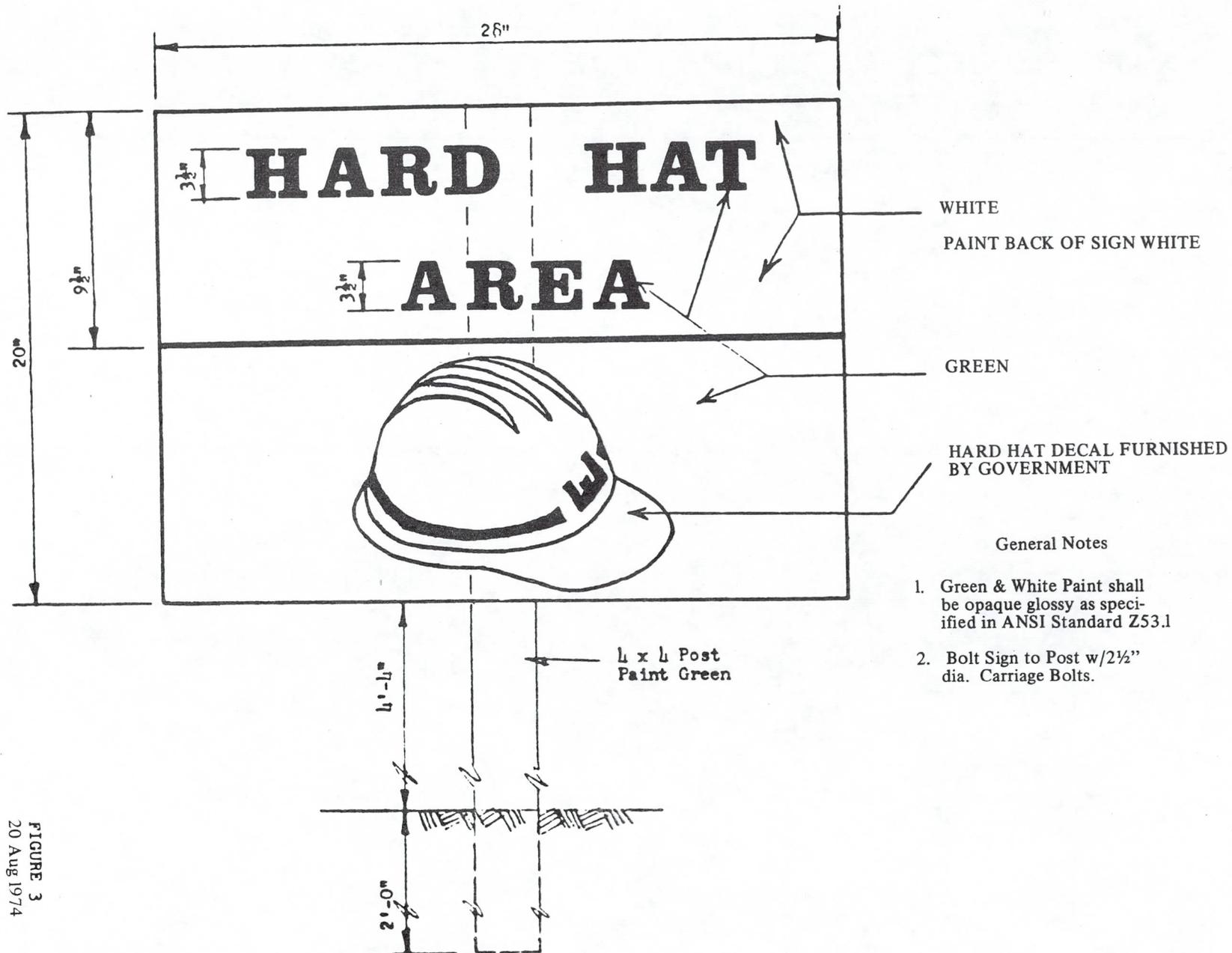


FIGURE 3  
20 Aug 1974

## SECTION 1B

### PAYMENT

1. THUNDERBIRD PASEO. Payment for Thunderbird Paseo will be made at the applicable contract price, which payment shall constitute full compensation for construction of recreation and esthetic treatment from 56th Avenue to Thunderbird Paseo Drive including jogging path from 56th Avenue to the centerline of 59th Avenue; drainage system from catch basins to outlet structures (including grouted stone and backfill); and irrigation system from approximately Station 311+00 to centerline 59th Avenue; complete.
2. 59TH AVENUE AND THUNDERBIRD ROAD PLAZA. Payment for 59th Avenue and Thunderbird Road Plaza will be made at the applicable contract price, which payment shall constitute full compensation for construction of recreation and esthetic treatment from 59th Avenue to Thunderbird Road including ramada and picnic tables; turf (including concrete headers from bottom of slope to low flow channel); jogging path from centerline 59th Avenue to the connection to access road north of Thunderbird Road; equestrian trail from right-of-way east of 59th Avenue to Station 244+26; drainage system from catch basins to outlet structures (including grouted stone and backfill); and irrigation system from centerline 59th Avenue to approximately Station 260+00; complete.
3. 67TH AVENUE PLAZA AND DESERT INTERPRETIVE GARDEN. Payment for 67th Avenue Plaza and Desert Intepretive Garden will be made at the applicable contract price, which payment shall constitute full compensation for construction of recreation and esthetic treatment from existing grouted stone spillway east of 67th Avenue to Station 203+00, including turf and concrete header from Station 213+00 to Station 205+00; jogging path from Station 243+07 to Station 186+32; drainage system from catch basins to outlet structures (including grouted stone and backfill); and irrigation system from approximately Station 220+00 to Station 203+00; complete.
4. EROSION CONTROL. Payment for Erosion Control will be made at the applicable contract price, which payment shall constitute full compensation for all erosion control work, except Side Drain, Station 298+36, outside the limits of recreation and esthetic treatment areas at Thunderbird Paseo, 59th Avenue and Thunderbird Road Plaza, 67th Avenue Plaza and Desert Interpretive Garden, Hard Surface Courts and General Purpose Paved Area. Payment shall include low flow channel concrete, all native (grasses) seeded areas, the swales from grouted stone spillways or outlet structure to the low flow channel, service road from north of Thunderbird Road to grouted stone spillway, and planting and irrigation outside the limits of other work, complete.
5. SIDE DRAIN, STATION 298+36. Payment for Side Drain, Station 298+36 will be made at the applicable contract price, which payment shall constitute full compensation for construction of the side drain, including earthwork, RCP, outlet structure, and swale, complete. Payment shall also include repair of eroded areas in the vicinity of Station 297+40.
6. IRRIGATION AUTOMATION. Payment for Irrigation Automation will be made at the applicable contract price, which payment shall constitute full compensation for automatic features of the irrigation system including irrigation controllers, moisture probes (tensiometers), central computer, and wiring and conduits from

valves, fertilizer injector systems, flow meters, and pressure sensors to controllers, complete.

7. HARD SURFACE COURTS. Payment for Hard Surface Courts will be made at the applicable contract price, which payment shall constitute full compensation for concrete paving, color coat, posts and backboards, complete. Payment will also include credit for seeding and irrigation not required as a result of award of this item.

8. GENERAL PURPOSE PAVED AREA. Payment for General Purpose Paved Area will be made at the applicable contract price, which payment shall constitute full compensation for construction of concrete paving sand base, volleyball net posts (including concrete footings, and attachments), boundary ropes and tie down blocks, complete. Payment will also include credit for seeding and irrigation not required as a result of award of this item.

\* \* \* \* \*

## SECTION 1C

### CONTRACTOR'S QUALITY CONTROL

#### Index

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 1. General                      | 6. Tests                         |
| 2. Quality Control Plan         | 7. Completion Inspection         |
| 3. Quality Control Organization | 8. Documentation                 |
| 4. Submittals                   | 9. Notification of Noncompliance |
| 5. Control                      |                                  |

1. GENERAL. The Contractor shall establish and maintain an effective quality control system in compliance with CONTRACT CLAUSE: INSPECTION OF CONSTRUCTION. The quality control system shall consist of plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with contract requirements. The system shall cover construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence.

#### 2. QUALITY CONTROL PLAN.

2.1 General. The Government will consider an interim plan for the first 25 days of operation. However, the Contractor shall furnish for approval by the Government, not later than 20 days after receipt of Notice to Proceed the Contractor Quality Control (CQC) Plan with which he proposes to implement the requirements of CONTRACT CLAUSE: INSPECTION OF CONSTRUCTION. The plan shall identify personnel, procedures, instructions, records, and forms to be used. If the Contractor fails to submit an acceptable QC plan with the time herein prescribed, the Contracting Officer (CO) may refuse to allow construction to start if an acceptable interim plan is not furnished or withhold funds from progress payments in accordance with the CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS until such time as the Contractor submits an acceptable final plan.

2.2 Coordination Meeting. Before start of construction, the Contractor shall meet with the CO and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's inspection and control with the Government's inspection. Minutes of the meeting shall be prepared and signed by both the Contractor and the CO. The minutes shall become a part of the contract file. There may also be occasions when subsequent conferences will be called to reconfirm mutual understandings.

2.3 The Quality Control Plan. This plan shall include as a minimum, the following:

2.3.1 A description of the quality control organization including chart showing lines of authority and acknowledgement that the CQC staff shall conduct the phase inspections for all aspects of the work specified and shall report to the project manager or someone higher in the Contractor's organization.

2.3.2 The name, qualifications, duties, responsibilities and authorities of each person assigned a QC functions.

2.3.3 A copy of the letter to the QC manager signed by an authorized official of the firm, which describes the responsibilities and delegates the authorities of the QC manager shall be furnished.

2.3.4 Procedures for scheduling and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.

2.3.5 Control testing procedures for each specific test. (Laboratory facilities will be approved by the Contracting Officer).

2.3.6 Reporting procedures including proposed reporting formats.

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

2.5 Notification of Changes. After acceptance of the QC plan, the Contractor shall notify the CO in writing of any proposed change. Proposed changes are subject to acceptance by CO.

### 3. QUALITY CONTROL ORGANIZATION.

3.1 System Manager. The Contractor shall identify an individual, within his organization at the site of the work, who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. This CQC System Manager shall be approved by the CO.

3.2 Personnel. A staff shall be maintained under the direction of the system manager to perform all QC activities. The actual strength of the staff during any specific work period may vary to cover work phase needs, shifts, and rates of placement. The personnel of this staff shall be fully qualified by experience and technical training to perform their assigned responsibilities and shall be directly hired by and work for the Prime Contractor.

4. SUBMITTALS. Submittals shall be as specified in the SPECIAL CLAUSE: SUBMITTALS. The CQC Organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

5. CONTROL. Contractor Quality Control is the means by which the Contractor assures himself that his construction complies with the requirements of the contract plans and specifications. The controls shall be adequate to cover all construction operations, including both onsite and offsite fabrication, and will be keyed to the proposed construction sequence. The controls shall include at least three phases of inspection for all definitive features of work as follows:

5.1 Preparatory Inspection. This shall be performed prior to beginning any work on any definable feature of work. It shall include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted and approved; a check to assure that provisions have been made

to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed; and a physical examination of materials, equipment and sample work to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. The Contracting Officer Representative (COR) shall be notified at least 24 hours in advance of the preparatory inspection and such inspection shall be made a matter of record in the Contractor's Quality Control documentation as required below. Subsequent to the preparatory inspection and prior to commencement of work, the Contractor shall instruct each applicable worker as to the acceptable level of workmanship required in his CQC plan in order to meet contract specifications.

5.2 Initial Inspection. This shall be performed as soon as a representative portion of the particular feature of work has been accomplished and shall include examination of the quality of workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements. The Contracting Officer's Representative shall be notified at least 24 hours in advance of the initial inspection and such inspection shall be made a matter of record in the CQC documentation as required below.

5.3 Follow-up Inspections. These shall be performed daily to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. Such inspections shall be made a matter of record in the CQC documentation as required below. Final follow up inspections shall be conducted and test deficiencies corrected prior to the addition of new features of work.

## 6. TESTS.

6.1 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 or he may establish an approved testing laboratory at the project site. A list of tests which the Contractor understands he is to perform shall be furnished as a part of the CQC plan to the Contracting Officer. The list shall give the test name, specification paragraph containing the test requirements, and the personnel and laboratory responsible for each type of test. The Contractor shall perform the following activities and record and provide the following data.

6.1.1 Verify that testing procedures comply with contract requirements.

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

6.1.3 Check test instrument calibration data against certified standards.

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

## 6.2 Testing.

6.2.1 Capability Check. The 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 laboratory technician's testing procedures and techniques.

6.2.2 Capability Re-Check. If the selected laboratory fails the capability check, the Contractor will be assessed a charge of \$675.00 to reimburse 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.

6.2.3 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.

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

For delivery by mail: Director  
South Pacific Division Laboratory  
U.S. Army Corps of Engineers  
P.O. Box 37  
Sausalito, CA 94966

For other deliveries: Director  
South Pacific Division Laboratory  
U.S. Army Corps of Engineers  
Bridgeway, Foot of Spring Street  
(building directly east of 2000 Bridgeway)  
Sausalito, CA 94965

7. COMPLETION INSPECTION. At the completion of all work or any increment thereof established by a completion time stated in the paragraph: COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK of the SPECIAL CLAUSES, or stated elsewhere in the specifications, the CQC System Manager shall conduct a completion inspection of the work and develop a punch list of items which do not conform to the approved plans and specifications. Such a list shall be included in the CQC documentation, as required by paragraph: DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or his staff shall make a second completion inspection to ascertain that all deficiencies have been corrected and so notify the Contracting Officer's Representative. The completion inspection and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

8. DOCUMENTATION.

8.1 The Contractor shall maintain correct records of quality control operations, activities, and tests performed including the work of suppliers and subcontractors. In addition, these records shall include factual evidence that the required activities or tests have been performed, including but not limited to the following:

8.1.1 Type and number of control activities and tests involved.

8.1.2 Results of control activities or tests.

8.1.3 Nature of defects, causes for rejection, etc.

8.1.4 Proposed remedial action.

8.1.5 Corrective actions taken.

8.1.6 Monitoring of materials and equipment upon arrival at the jobsite and prior to incorporation into the work for compliance with submittal approvals, damage and proper storage.

8.1.7 Offsite surveillance activities.

8.2 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 CO not later than 12:00 (noon) for the preceding days activity.

9. 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 damage by the Contractor.

\* \* \* \* \*

## SECTION 1D

### ENVIRONMENTAL PROTECTION

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- |                    |  |
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| 1. Scope           | 6. Protection of Environmental Resources                 |
| 2. Quality Control | 7. Restoration of Landscape Damage                       |
| 3. Submittals      | 8. Training of Contractor Personnel in Pollution Control |
| 4. Subcontractors  |  |
| 5. Notification    |  |

1. SCOPE. This section covers prevention of environmental pollution and damage as the result of construction operations under this contract and for those measures set forth in other Technical Provisions of these specifications. For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, and land, and includes management of visual aesthetics, noise, solid waste, radiant energy and radioactive materials, as well as other pollutants.

2. QUALITY CONTROL. The Contractor shall establish and maintain quality control for environmental protection of all items set forth herein. The Contractor shall record on daily reports any problems in complying with laws, regulations and ordinances and corrective action taken.

3. SUBMITTALS. The Contractor shall submit an environmental protection plan in accordance with provisions as herein specified.

3.1 Environmental Protection Plan shall include but not be limited to the following:

(1) A list of Federal, State and local laws, regulations, and permits concerning environmental protection, pollution control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations and permits.

(2) Methods for protection of features to be preserved within authorized work areas. The Contractor shall prepare a listing of methods to protect resources needing protection, i.e., trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archeological and cultural resources and to replace and restore damaged resources.

(3) Procedures to be implemented to provide the required environmental protection and to comply with the applicable laws and regulations. The Contractor shall set out the procedures to be followed to correct pollution of the environment due to accident, natural causes or failure to follow the procedures set out in accordance with the environmental protection plan.

(4) Permit or license and the location of the solid waste disposal area.

(5) Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.

(6) Environmental monitoring plans for the job site, including land, water, air, and noise monitoring.

(7) Traffic control plan.

(8) Methods of protecting surface and groundwater during construction activities.

(9) Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or non-use. Plan should include measures for marking the limits of use areas.

3.2 Implementation. The Contractor shall submit in writing the above Environmental Protection Plan within 15 days after receipt of Notice to Proceed. Approval of the Contractor's plan will not relieve the Contractor of his responsibility for adequate and continuing control of pollutants and other environmental protection measures.

4. SUBCONTRACTORS. Assurance of compliance with this section by subcontractors will be the responsibility of the Contractor.

5. NOTIFICATION. The Contracting Officer will notify the Contractor in writing of any observed noncompliance with the aforementioned Federal, State or local laws or regulations, permits and other elements of the Contractor's environmental protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of proposed corrective action and take such action as may be approved. If the Contractor fails 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 time extensions shall be granted or costs or damages allowed to the Contractor for any such suspension.

6. PROTECTION OF ENVIRONMENTAL RESOURCES. The environmental resources within the project boundaries and those affected outside the limits of permanent work under this Contractor shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the drawings and specifications. Environmental protection shall be as stated in the following subparagraphs.

6.1 Protection of Land Resources. Prior to the beginning of any construction, the Contractor shall identify all land resources to be preserved within the Contractor's work area. The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without special permission from the Contracting Officer. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. Where such special emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs.

6.1.1 Work Area Limits. Prior to any construction the Contractor shall mark the areas that are not required to accomplish all work to be performed under this contract. Isolated areas within the general work area which are to be saved and protected shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The Contractor shall convey to his personnel the purpose of marking and/or protection of all necessary objects.

6.1.2 Protection of Landscape. Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques.

6.1.3 Reduction of Exposure of Unprotected Erodible Soils. Earthwork brought to final grade shall be finished as indicated and specified. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils.

6.1.4 Location of Field Offices, Storage and Other Contractor Facilities. The Contractors' field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated and/or shown on the drawings. Temporary movement or relocation of Contractor facilities shall be made only on approval by the Contracting Officer.

6.1.5 Spoil Areas shall be managed and controlled to limit spoil to areas designated on the drawings and prevent erosion of soil or sediment from entering nearby water courses or lakes. Spoil areas shall be developed in accordance with the grading plan indicated on the drawings.

6.1.6 Temporary Excavations and Embankments for plant and/or work areas shall be controlled to protect adjacent areas from spoils.

6.1.7 Disposal of Solid Wastes. Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. All handling and disposal shall be conducted to prevent contamination.

6.1.8 Disposal of Chemical Waste. Chemical waste shall be stored in corrosion resistant containers, removed from the work area and disposed of in accordance with Federal, State and local regulations.

6.1.9 Disposal of Discarded Materials. Discarded materials other than those which can be included in the solid waste category will be handled as directed by the Contracting Officer.

6.2 Preservation and Recovery of Historical, Archeological and Cultural Resources shall conform to the SECTION: GENERAL REQUIREMENTS.

6.3 Protection of Water Resources. The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface and groundwaters. Special management techniques as set out below shall be implemented to control water pollution by the listed construction activities which are included in this contract.

6.3.1 Washing and Curing Water. Waste waters directly derived from construction activities shall not be allowed to enter water areas. These waste waters shall be collected and placed in retention ponds where suspended material can be settled out or the water evaporates so that pollutants are separated from the water.

6.3.2 Monitoring of Water Areas Affected by Construction Activities shall be the responsibility of the Contractor. All water areas affected by construction activities shall be monitored by the Contractor.

6.4 Protection of Wildlife Resources. The Contractor shall keep construction activities under surveillance, management and control to minimize interference with, disturbance to and damage of fish and wildlife. Species that require specific attention along with measures for their protection will be listed by the Contractor prior to beginning of construction operations.

6.5 Protection of Air Resources. The Contractor shall keep construction activities under surveillance, management and control to minimize pollution of air resources. All activities, equipment, processes, and work operated or performed by the Contractor in accomplishing the specified construction shall be in strict accordance with the State of Arizona and all Federal emission and performance laws and standards. Ambient Air Quality Standards set by the Environmental Protection Agency shall be maintained for those construction operations and activities specified in this section. Special management techniques as set out below shall be implemented to control air pollution by the construction activities which are included in the contract.

6.5.1 Particulates. Dust particles, aerosols, and gaseous by-products from all construction activities, processing and preparation of materials, such as from asphaltic batch plants, shall be controlled at all times, including weekends, holidays and hours when work is not in progress.

6.5.1.1 Particulates Control. The Contractor shall maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause the air pollution standards mentioned in paragraph: Protection of Air Resources, above to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated at such intervals as to keep the disturbed area damp at all times. The Contractor must have sufficient competent equipment available to accomplish this task. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

6.5.2 Hydrocarbons and Carbon Monoxide. Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and State allowable limits at all times.

6.5.3 Odors. Odors shall be controlled at all times for all construction activities, processing and preparation of materials.

6.5.4 Monitoring of Air Quality shall be the responsibility of the Contractor. All air areas affected by the construction activities shall be monitored by the Contractor.

6.6 Protection of Sound Intrusions. The Contractor shall keep construction activities under surveillance, and control to minimize damage to the environment by noise. The Contractor shall use methods and devices to control noise emitted by equipment to the levels shown.

7. RESTORATION OF LANDSCAPE DAMAGE. The Contractor shall restore all landscape features damaged or destroyed during construction operations outside the limits of the approved work areas. Such restoration shall be in accordance with the approved environmental protection plan. This work shall be accomplished at the Contractor's expense.

8. TRAINING OF CONTRACTOR PERSONNEL IN POLLUTION CONTROL. The Contractor shall train his personnel in all phases of environmental protection. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual, and installation and care of facilities (vegetative covers, and instruments required for monitoring purposes) to ensure adequate and continuous environmental pollution control.

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SECTION 2A

DIVERSION AND CONTROL OF WATER

1. GENERAL.

1.1 Requirements. All permanent construction shall be carried on in areas free from water. Water in varying quantities may be flowing in the channel during the entire period of construction as a result of either rainfall or releases from the Arizona Canal wasteway. Runoff from the watersheds is rapid, and, during periods of rain, intermittent freshets may be expected. The responsibility of the Contractor for protection of work against water flows is specified in paragraph: PERMITS AND RESPONSIBILITIES of the CONTRACT CLAUSES. At all locations, all subgrades, whether for earth fill, stone, or concrete, shall be kept drained and free of water throughout the working period. Within 10 days after receipt of Notice to Proceed, the Contractor shall submit plans showing the method that he proposes to use to dewater each working area and control the water from rain, sheet flow, stream flow, and any other surface water. The plans shall show the scheme of operations and a complete layout of drainage pipes, pumps, diversion channels, cofferdams, etc. The plans shall also take into consideration the following specific requirements.

1.2 Flood Flows. The Contractor shall provide for diversion of channel flows as hereinafter specified. The channel flows will include water originating from upstream of the work; urban runoff; adjacent drainages; and the Arizona Canal wasteway, in addition to any and all seepage originating within the work. Flood flows from these sources might be expected to add up to 6000 cfs.

1.3 Drainage Ditches. The construction of any drainage ditches not otherwise shown in the plans shall be subject to the approval of the Contracting Officer. Special precautions shall be taken to avoid impairing the permanent subgrade, and any excavation below the existing streambed or invert subgrade shall be refilled with compacted fill in accordance with SECTION: EXCAVATION, TRENCHING, and BACKFILLING for UTILITIES SYSTEMS by and at the expense of the Contractor.

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SECTION 2B

CLEARING SITE AND REMOVING OBSTRUCTIONS

1. GENERAL. Except as otherwise specified or indicated, areas to be cleared and grubbed will be limited to actual areas on which fills, desert gravel or plant materials are to be placed. The removal of trees, shrubs, turf, and other vegetation outside of these areas shall be held to a minimum and care shall be exercised not to damage any trees, shrubs, or vegetation which can be left in place. Except as otherwise specified or indicated materials to be removed are scrap, shall become the property of the Contractor, and removed from the site.
2. EXISTING STRUCTURES AND OBSTRUCTIONS. The Contractor shall clear the site, including all fill and excavation areas, remove and dispose of all obstructions for project beautification, except as otherwise noted on the drawings. Existing structures and obstructions designated to be removed by others shall be protected in place. Except as otherwise specified, obstructions designated to be removed by others will be removed in sufficient time to preclude interference with the Contractor's operations. Utility relocations are not considered obstructions.
3. CLEARING. Vegetation to be removed, unless otherwise noted, shall be cut off flush or slightly below the original ground surface. Clearing operations shall be conducted so as to prevent damage to trees, structures, and installations under construction, or to remain in place, and to provide for the safety of employees and others. All rubbish, waste dumps, and debris areas shall be cleared.
4. GRUBBING shall consist of removing all stumps, roots, logs, and other objectionable vegetable and non-vegetable matter in the areas where work is to be done. In grubbing out stumps and roots, all roots or other timber more than 1-1/2 inches in diameter shall be removed to below the depth of the required excavation or existing ground level, whichever is lower. Stumps shall be pulled, not cut off. The Contractor shall ensure that weeds are removed and destroyed during the plant establishment period as described in SECTION: SEEDING and SECTION: CACTI, TREES, SHRUBS, GROUND COVERS, VINES, AND NATIVE ROCK.
5. FILLING OF HOLES. Holes made by removal of obstructions and grubbing operations shall be backfilled to subgrade as specified in the SECTION: EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.
6. THE REMOVAL OF MATERIALS FOR SALVAGE shall be accomplished without damage to such materials and to portions of existing work to remain in place. The Contractor has the option of furnishing new materials in lieu of salvaging such materials. Such new materials shall be the equivalent of existing materials.
7. ROCKS encountered during clearing operations in areas designated for planting trees, shrubs and ground cover with a dimension greater than 6 inches shall be removed.
8. BURNING. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

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SECTION 2C

EXCAVATION, FILLING AND BACKFILLING FOR STRUCTURES

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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 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-in. (457-mm) Drop
D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
D 2487-85	Classification of Soils For Engineering Purposes

2. DEFINITIONS.

2.1 Satisfactory Materials. Satisfactory materials include materials classified in ASTM D 2487 as GW, GP, SW, SP, GM, GC, SM, SC, ML and CL and shall be free of trash, debris, roots or other organic matter, or stones larger than 3 inches in any dimension.

2.2 Unsatisfactory Materials. Unsatisfactory materials include materials classified in ASTM D 2487 as Pt, OH, OL, MH, and CH, refuse, and any other material not defined as satisfactory.

3. EXCAVATION.

3.1 Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified hereinafter, and shall include trenching for utility systems to a point 5 feet beyond the building line of each building and structure, and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material.

Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations. Satisfactory material shall be placed and compacted as specified in paragraph: COMPACTED FILL. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.2 Drainage. Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.3 Blasting will not be permitted.

3.4 Utility and Drain Trenches. Trenches for underground utilities systems more than 5 feet beyond the building line and drain lines shall conform to SECTION: EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.5 Excavated Materials. Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall become the property of the Contractor and shall be removed from the site.

3.6 Final Grade of Surfaces to Support Concrete. Excavation to final grade shall not be made until just before concrete is to be placed.

4. COMPACTED FILL. Satisfactory materials free from roots, debris or stones larger than 3 inches shall be used in bringing fills to the lines and grades indicated and for replacing unsatisfactory materials. Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. The surfaces shall be scarified to a depth of 8 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. Satisfactory material shall be placed in horizontal layers not exceeding 6 inches in loose depth and then compacted. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Each layer shall be compacted to not less than 90 percent of maximum density.

5. SUBGRADE PREPARATION. The subgrade shall be alternately watered and scarified until the material is uniformly moistened throughout for a depth of not less than 6 inches. All stones larger than 3 inches in diameter and all hard ribs of earth shall be removed. The amount of water to be applied shall be that which is required to provide optimum results in compaction under rolling. The subgrade, excepting subgrade for concrete walk, asphaltic concrete and stone paving, shall

be thoroughly compacted to not less than 90 percent of maximum density. The subgrade for concrete walk, asphaltic concrete, and stone paving shall be thoroughly compacted to not less than 95 percent of maximum density.

5.1 Subgrade Preparation for Concrete Sidewalk shall conform to the applicable requirements of SECTION: CONCRETE SIDEWALKS, CURB AND GUTTERS, AND SLOPE PROTECTION.

6. BACKFILLING. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Backfill shall be of satisfactory materials, placed and compacted as specified under paragraph: COMPACTED FILL. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than one inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings or wrappings. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

7. TESTING shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval in accordance with SECTION: CONTRACTOR'S QUALITY CONTROL. Moisture-density relations shall be determined in accordance with ASTM D 1557. Field in-place density shall be determined in accordance with ASTM D 1556. Moisture-density relations and field densities shall be reported on approved forms. One copy of density data less dry weight-determinations shall be provided on the day each test is taken. The completed test reports shall be provided with the Contractor Quality Control Report on the work day following the test. Approved, compacted subgrades that are disturbed by the Contractor's operations or adverse weather, shall be scarified and compacted as specified. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation.

7.1 In-Place Densities.

7.1.1 In-Place Density of Subgrades. At least one test per structure and at least one test per 8,000 square feet or fraction thereof.

7.1.2 In-Place Density of Fills and Backfills. Three tests for each fill or backfill area.

8. GRADING. Areas within 5 feet outside of each building and structure line as well as the site shall be constructed true to grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

8.1 All planting areas shall be fine graded and soil conditioners added. Reference SECTIONS: CACTI, TREES, SHRUBS, GROUND COVERS, VINES AND NATIVE ROCK; SEEDING.

9. PROTECTION. Settlement or washing that occurs in graded or backfilled areas prior to acceptance of the work shall be repaired and grades re-established to the required elevations and slopes.

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SECTION 2D

EXCAVATION, TRENCHING, AND BACKFILLING  
FOR UTILITIES SYSTEMS

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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 of 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-in. (457-mm) Drop
D 2487-85	Classification of Soils for Engineering Purposes

1.2 Arizona Public Service Details & Specifications (Electrical Distribution Systems).

2. DEFINITIONS.

2.1 Satisfactory Backfill Materials. Satisfactory backfill materials shall consist of any material classified by ASTM D 2487 as SP, GW, GP, GM, GC, SM, SC, and SW.

2.2 Unsatisfactory Materials. Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory 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 by ASTM D 2487, as CH, MH, PT, OH, and OL. Unsatisfactory materials also include refuse.

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, CL, MH, and CH. Materials classified as GM, ML, and SM will be identified as cohesionless only when the fines are nonplastic.

2.4 Unyielding Material. Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.5 Unstable Material. Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.6 Initial Backfill Material. Material for the initial backfill shall be clean sand free of trash, organic material, and debris, with 100 percent passing the No. 4 sieve and not more than 10 percent passing the No. 100 sieve.

2.7 Backfill Materials for Irrigation System. Backfill material shall be screened to remove any stone larger than one inch and may consist of sand and gravelly sand.

2.8 Backfill Materials for Electrical System. Backfill material shall be pea gravel. Pea gravel shall be crushed or natural material, washed and uniformly graded between 1/4 and 3/8 inch size.

3. GENERAL QUALITY CONTROL TESTING shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government in accordance with SECTION: CONTRACTOR'S QUALITY CONTROL.

3.1 Testing Facilities. Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor.

3.2 Testing of Backfill Materials. "Moisture-density relations shall be determined in accordance with ASTM D 1557. Field in-place density shall be determined in accordance with ASTM D 1556. Moisture-density relations and field densities shall be reported on approved forms. One copy of density data less dry weight determinations shall be provided on the day each test is taken."

3.3 Construction Quality Control. Quality control sampling and testing during construction shall be performed as required in paragraph: FIELD QUALITY CONTROL.

4. EXCAVATION shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or unsatisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. - Unauthorized overexcavation shall be backfilled in accordance with paragraph: BACKFILLING AND COMPACTION at no additional cost to the Government.

4.1 Trench Excavation. The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and shall be of the width recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave-in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, the Contractor shall redesign or use stronger pipe or special installation procedures. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

4.1.1 Bottom Preparation. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

4.1.2 Removal of Unyielding Material. Where unyielding material is encountered in the bottom of the trench, such material shall be removed 12 inches below the required grade and replaced with suitable materials as provided in paragraph: BACKFILLING AND COMPACTION.

4.1.3 Removal of Unstable Material. Where wet or otherwise unstable material incapable of properly supporting the pipe as determined by the Contracting Officer is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with initial backfill material as provided in paragraph: BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

4.2 Excavation for Appurtenances. Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

4.3 Stockpiles. Stockpiles of satisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

5. BACKFILLING AND COMPACTION. Backfill material shall consist of satisfactory material or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 90 percent maximum density, unless otherwise specified.

5.1 Trench Backfill. Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test. The trench shall not be completely backfilled until all specified tests are performed.

5.1.1 Replacement of Unyielding Material. Unyielding material removed from the bottom of the trench shall be replaced with initial backfill material.

5.1.2 Replacement of Unstable Material. Unstable material removed from the bottom of the trench or excavation shall be replaced with initial backfill material placed in layers not exceeding 6 inches loose thickness.

5.1.3 Bedding for Sanitary Sewers. Bedding for sanitary sewers shall consist of initial backfill material. The bottom portion of the trench shall be brought to grade so that the sewer will be continuously in contact with the material on which it is being placed.

5.1.4 Initial Backfill. Initial backfill material shall be placed and compacted to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Water shall be applied to the initial backfill material by jetting in a manner, quantity, and at a rate sufficient to thoroughly saturate the entire lift. Vibrating compacting equipment shall be used to obtain not less than 85 percent of maximum density.

5.1.5 Final Backfill. The remainder of the trench, shall be filled with satisfactory material. Backfill material shall be placed and compacted to a density of at least 90 percent maximum density. Water jetting or jetting methods of compaction will not be permitted.

5.2 Backfill for Appurtenances. After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

6. SPECIAL REQUIREMENTS for both excavation and backfill relating to the specific utilities (irrigation system excepted) are as follows.

6.1 Water Lines. Trenches shall be of a depth to provide a minimum cover of 2 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 24 inches of cover is required.

6.2 Electrical Distribution System. Conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated.

6.2.1 Distribution of primary and secondary service lines to the customer disconnect shall be installed per Arizona Public Service details and specifications.

6.3 Plastic Marking Tape. Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown. The tape shall be acid and alkali-resistant Polyethylene film, 6 inches wide with a minimum thickness of .004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation 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
Yellow:	Gas, O.l, Dangerous Material
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

7. FIELD QUALITY CONTROL. Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

7.1 Field Density Tests. Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 200 linear feet of installation shall be performed. A minimum of one moisture density relationship will be performed for each classification, change in classification, or blend of material being compacted. When the classification remains consistent, a minimum of one moisture-density relationship will be performed for each 1500 cubic yards. The soil used for each maximum density shall be classified in accordance with ASTM D 2487.

7.1.1 In place densities shall be in accordance with ASTM D 1556.

7.1.2 Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests, shall be furnished to the Contracting Officer. If compaction is not as specified, the material shall be removed, replaced and recompacted to meet specification requirements, at no additional expense to the government. Tests on recompacted areas shall be performed to determine conformance with specification requirements.

7.2 Displacement of Sewers. After other required tests have been performed and the trench backfill compacted to 2 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. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

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SECTION 2E

SIDE DRAINS

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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.).

SS-S-210	Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
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1.2 Federal Test Method Standard (Fed. Std.).

601	Rubber
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1.3 American Association of State Highway and Transportation Officials (AASHTO), Standards.

M 86-73I	Concrete Sewer, Storm Drain, and Culvert Pipe
M 170-73I	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
M 198-75 (R 1986)	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

1.4 American Society for Testing and Materials (ASTM) Standards.

C 14-75	Concrete Sewer, Storm Drain, and Culvert Pipe
C 76-75	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C 231-82	Air Content of Freshly Mixed Concrete by the Pressure Method
C 270-73	Mortar for Unit Masonry

C 443-79	Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
D 1556-82	Density of Soil in Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils, Using 10-lb. (4.5-Kg) Rammer and 18-in. (457-mm) Drop
D 1751-73	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-67	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

## 2. DELIVERY, STORAGE, AND HANDLING OF MATERIALS.

2.1 Delivery and Storage. Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

2.2 Handling. Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried to the trench not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

3. MANUFACTURER'S RECOMMENDATIONS. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

4. TESTS FOR PIPE. Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed. Strength tests for concrete, clay, and asbestos-cement pipe as required in applicable specifications shall be the three-edge bearing tests.

5. PIPE AND CULVERTS shall be as indicated and shall conform to requirements for the following pertinent types.

5.1 Reinforced Concrete Pipe. ASTM C 76 or AASHTO M 170, type as shown on the drawings.

6. DRAINAGE STRUCTURES shall be of the following types, constructed of the materials specified for each type and in accordance with the indicated details.

6.1 Walls and Headwalls. Construction shall be of reinforced concrete or plain concrete, as indicated.

6.2 Flared End Sections. Sections shall be of a standard design with pipe and material the same as specified for the pipe.

#### 7. MATERIALS FOR DRAINAGE STRUCTURES.

7.1 Concrete. Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements of the SECTION: CONCRETE, 3,000 psi compressive strength at 28 days. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches unless otherwise specified. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall be not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least three inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751 and D 1752, or shall be resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

7.2 Mortar. Mortar for pipe joints and connections to other drainage structures shall conform to ASTM C 270, Type M, except the maximum placement time shall be 30 minutes after the ingredients are mixed with water.

7.2.1 The inside of the joint shall be wiped clean and finished smooth. In pipe too small for a man to work inside, wiping may be done by dragging a suitable swab or long-handled brush through the pipe as work progresses. The mortar bead on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

#### 8. CONCRETE PIPE JOINTS.

8.1 Rubber Gasket Joint. Design of joints and physical requirements for rubber-type gaskets shall conform to ASTM C 443 or AASHTO M 198. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber gasket type are permitted if nominal diameter of pipe being gasketed exceeds 54 inches. Material conforming to Fed. Spec. SS-S-210 is acceptable as an alternate to ASTM C 443 provided the necessary installation instructions are furnished. Gaskets or jointing materials shall not swell more than 100 percent by volume when immersed in accordance with Method 6211 of Fed. Std. 601, in immersion medium No. 3 for 70 hours at 212 degrees F. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished if specifically approved. Gaskets and joining materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall

be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through the exterior joint recess when joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

9. EXCAVATION, TRENCHING AND BACKFILLING FOR PIPE CULVERTS. Excavation and backfilling of trenches shall be in accordance with the applicable portions of SECTION: EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS and the following requirements.

9.1 Removal of Rock. Rock in either ledge or boulder formation shall be replaced with selected materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2-inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe.

9.2 Removal of Unstable Material. Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is encountered in bottom of trench, such material shall be removed to depth required and replaced to the proper grade with selected material, compacted as provided in paragraph: BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, resulting material shall be excavated and replaced.

10. MATERIALS FOR BEDDING AND BACKFILLING.

10.1 General. Bedding and sand fill for culverts shall consist of sand fill placed around the pipe in accordance with paragraph: BACKFILLING. Compacted fill above the springing line shall be placed in accordance with paragraph: BACKFILLING.

10.1.1 Material for the bedding and sand fill for the culvert shall be clean sand, free of trash, organic materials, debris, and with 100 percent passing the No. 4 sieve and not more than 10 percent passing the No. 100 sieve.

10.1.2 Material for the compacted fill to 24" above the springing line shall not contain any stone larger than 3/4 inch and may consist of sand, gravelly sand, silty sands, sandy silts, clayey sands, and sandy clays. Organic material, silt, clay, broken concrete or pavement, boulders and other objectionable material shall not be used.

11. PLACING.

11.1 Bedding. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. The pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe, or to the lower curved portion of pipe arch for the entire length of pipe or arch. When

necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type joint.

11.2 PIPE. Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those damaged during placement shall be removed and replaced at no additional cost to the Government.

11.2.1 Concrete Pipe. Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

## 12. BACKFILLING.

12.1 Backfilling Pipe in Trenches. After the bedding has been prepared and the pipe installed, sand fill material, shall be placed along both sides of pipe in a single lift to the springing line (maximum horizontal dimension of a pipe). The sandfill shall be brought up evenly on both sides of pipe for the full length of pipe. Water shall be applied to the sand fill by jetting in a manner, quantity, and at a rate sufficient to thoroughly saturate the entire lift. Vibrating compacting equipment shall be used to obtain not less than 85 percent of maximum density. Care shall be taken to insure thorough compaction of the sand fill under the haunches of the pipe. Above the springing line, the trench shall be filled with compacted fill conforming to paragraph: MATERIALS FOR BEDDING AND BACKFILLING. The compacted fill material, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 4 inches in compacted depth. The compacted fill shall be brought up evenly on both sides of pipe for the full length of pipe. Each layer shall be thoroughly compacted with mechanical tampers or vibrators to not less than 85 percent of maximum density. This method of filling and compacting shall continue until the fill has reached an elevation of at least 24 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by the spreading and rolling or compacted by mechanical tampers or vibrators in layers not exceeding 6 inches compacted to 90 percent of maximum density. Where it is necessary in the opinion of the Contracting Officer, any sheeting and/or portions of bracing used shall be left in place, and the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

12.2 Backfilling Pipe in Fill Sections. For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified above. The fill material above the springing line shall be uniformly spread in layers longitudinally on both sides of pipe, not exceeding 4 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or vibrating to obtain not less than 85 percent of maximum density. Prior to commencing normal filling operations, the crown width of the fill at a height of 24 inches above the top of the pipe shall extend a distance of

not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 24 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted to 90 percent of maximum density in layers not exceeding 6 inches.

12.3 Movement of Construction Machinery. In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert at any stage of the construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at the expense of the Contractor.

12.4 Compaction.

12.4.1 Laboratory Control. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557.

12.4.2 Field Control. Tests shall be well distributed and shall average not less than one test for each 200 lineal feet of trench for each 2 feet or less of backfill. At least one test shall be made in each trench. Field in-place density shall be determined in accordance with ASTM D 1556.

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SECTION 2F

SANITARY SEWERS

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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 Specifications (Fed. Spec.).

RR-F-621C	Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
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1.2 American Society for Testing and Materials (ASTM) Publications.

A 48-83	Gray Iron Castings
A 123-84	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 536-84	Ductile Iron Castings
C 33-86	Concrete Aggregates
C 94-86a	Ready-Mixed Concrete
C 139-73 (R 1985)	Concrete Masonry Units for Construction of Catch Basins and Manholes
C 150-85a	Portland Cement
C 425-77	Compression Joints for Vitriified Clay Pipe and Fittings
C 478-85a	Precast Reinforced Concrete Manhole Sections
C 700-78a (R 1983)	Vitriified Clay Pipe, Extra Strength, Standard Strength and Perforated
C 828-80	Low Pressure Air Test of Vitriified Clay Pipe Lines

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
D 3350-84	Polyethylene Plastics Pipe and Fittings Materials
D 3753-81 (R 1986)	Glass-Fiber Reinforced Polyester Manholes
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.

49-1975	Hazardous Chemicals Data
325M-1984	Flammable Liquids, Gases and Volatile Solids
704-1985	Identification of the Fire Hazards of Materials

2. GENERAL REQUIREMENTS. The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Excavation and backfilling shall conform to SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer.

3. CERTIFICATES OF COMPLIANCE stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes shall be submitted in accordance with the SPECIAL CLAUSES.

4. PIPE may be of any of the following materials unless otherwise specified or indicated.

4.1 Clay Pipe and Fittings. ASTM C 700 extra strength. Compression joints shall conform to ASTM C 425.

4.2 Plastic Pipe.

4.2.1 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.

4.2.2 High Density Polyethylene Pipe and Fittings Materials.

4.2.3 Joints.

4.2.3.1 Poly Vinyl Chloride (PVC) Pipe. Elastomeric gasket joint in accordance with ASTM D 3212.

4.2.4 Branch Connections. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for poly vinyl chloride (PVC) pipe shall comply with Table 4 of ASTM D 3034.

4.2.5 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.

5. CEMENT MORTAR shall conform to ASTM C 270, Type M with Type II cement.

6. FRAMES AND COVERS shall be cast iron, ductile iron or reinforced concrete. Cast-iron frames and covers shall be as indicated in all essentials of design or to Fed. Spec. RR-F-621, type as suitable for the application, circular, without vent holes. 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 letter "S", at least 2 inches high, shall be stamped or cast into all covers so as to be plainly visible. Reinforced concrete frames and covers shall be as indicated. Ductile iron for frames and covers shall conform to ASTM A 536.

7. LADDERS FOR MANHOLES shall be of steel, straight-type, not less than 16 inches in width with 7/8-inch diameter rungs spaced 12 inches on center. Rails shall be not less than 2 inches by 1/2 inch in section. Ladders shall be supported by steel inserts spaced not more than 6 feet apart vertically and so installed to provide at least 6-1/2 inches of toe space between the wall and inside of the rungs. The ladder and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

8. PORTLAND CEMENT shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

9. PORTLAND CEMENT CONCRETE shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete thrust blocking, for cradle and encasement, or for concrete blocks for manholes. Concrete used for thrust blocking and cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

10. PRECAST REINFORCED CONCRETE MANHOLE SECTIONS shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, or an approved mastic or rubber gasket, or an approved combination of these types.

## 11. INSTALLATION.

### 11.1 Adjacent Facilities.

11.1.1 Water Lines. Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

11.1.2 Roads. At road crossings, the sewer pipe shall be suitably encased in a sleeve of rigid conduit for the length installed under such facilities and for additional length beyond these facilities as shown. The pipe sleeve shall be as required by the authority having jurisdiction, or it shall be of reinforced concrete, steel, or cast grey or ductile iron pipe of the weight, class, size, and strength required for the anticipated superimposed loads. A minimum clearance of at least 2 inches between the inner diameter of the sleeve and the maximum outside diameter of the sleeved pipe, including the joints, shall be provided. Sand bedding shall be provided for the carrier pipe through the sleeve. Sleeves of ferrous material shall be provided with corrosion protection as required for the conditions encountered at the site of installation.

11.1.3 Structures. Where sewer pipe is required to be installed within 3 feet of an existing building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Care shall be exercised and proper precautions taken during installation of the sewer pipe and sleeve to assure that there will be no damage to such structures and no settlement or movement of foundations or footing. Any damage occurring as a result of the Contractor's operation shall be corrected and all costs connected therewith shall be borne by the Contractor. When the sewer pipe location is within 3 feet of a proposed building, retaining wall, or structural foundation as stated above, the pipe shall be sleeved as required for an existing structure.

### 11.2 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 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. Installations of solvent weld joint pipe, using 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.

11.2.1 Caulked Joints. The packing material shall be well packed into the annular space so as to prevent the entrance of lead into the pipe. The remainder of the space shall be filled with molten lead that is hot enough to show a rapid change in color when stirred. Scum shall be removed before pouring. The lead shall be caulked to form a tight joint without overstraining the bell and shall have a minimum depth of one inch after caulking.

11.2.2 Trenches. Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

11.2.3 Backfill. As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

11.2.4 Width of Trench. If the maximum width of the trench at the top of the pipe, as specified in SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install at no additional cost to the Government such concrete cradling, pipe encasement, or other bedding as may be required to satisfactorily support the added load of the backfill.

11.2.5 Joints. Joints between different pipe materials shall be made as hereinbefore specified, using approved jointing materials.

11.2.6 Handling and Storage. Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325M.

11.3 Leakage Tests. Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permitted 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 0.2 gallons 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.

11.4 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. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 95 percent of the normal inside diameter of the pipe. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F., and shall have a surface brinell hardness of not less than 150. It shall be center bored and through bolted with a 1/4-inch minimum diameter steel shaft having a yield strength of 70,000 psi or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer such that a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be so spaced that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described hereinbefore, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections of 4.5 percent of the normal diameter of the pipe shall be retested by a run from the opposite direction. If the retest indicates a deflection in excess of the 4.5 percent, the suspect pipe shall be replaced. Any pipe showing deflections in excess of 5 percent at the end of one year following installation and acceptance will be replaced at no cost to the Government.

12. WYE BRANCHES shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When conditions are such that the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

13. MANHOLES.

13.1 General. Manholes shall be constructed of polyester and fiberglass or of concrete precast concrete rings, with cast iron, ductile iron or reinforced-concrete frames and covers, as indicated. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard o-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than one inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed one 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 one foot 6 inches.

13.2 Manhole Ladder. When the depth from top of cover to invert of main sewer exceeds 12 feet, manholes shall be provided with a steel ladder. The manhole wall along the line of the ladder shall be vertical for its entire height.

13.3 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.

13.4 Frames and Covers. Unless otherwise indicated, 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.

14. CONNECTIONS TO EXISTING MANHOLES. Pipe connections to existing manholes shall be made in such manner that the finish work will conform as nearly as practicable to the essential applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping.

15. BUILDING CONNECTIONS shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

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SECTION 2G

WATER LINES

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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 Specifications (Fed. Spec.).

WW-P-325B	Pipe, Bends, Traps, Caps and Plugs; Lead (for Industrial Pressure, and Soil and Waste Applications)
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1.2 American National Standards Institute, Inc. (ANSI) Standards.

B1.20.1-1983	Pipe Threads, General Purpose (Inch)
B16.1-1975	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
B16.3-1985	Malleable Iron Threaded Fittings Class 150 and 300
B16.26-1983	Cast Copper Alloy Fittings for Flared Copper Tubes
B36.10-1979	Welded and Seamless Wrought Steel Pipe

1.3 American Society for Testing and Materials (ASTM) Publications.

A 120-84	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
B 88-86	Seamless Copper Water Tube
D 1599-86	Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings

1.4 American Water Works Association (AWWA) Standards.

B300-80	Hypochlorites
B301-81	Liquid Chlorine

C104-85	Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water
C105-82	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
C110-82	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
C111-85	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
C151-81 & Erratum	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
C200-80	Steel Water Pipe 6 In. and Larger
C203-78	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot-Applied
C205-80	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 in. and Larger--Shop Applied
C207-78	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 in.
C208-83	Dimensions for Fabricated Steel Water Pipe Fittings
C300-82	Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
C301-84 & Erratum	Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
C303-78 & C303a-81	Reinforced Concrete Pressure Pipe-Steel Cylinder Type, Pretensioned, for Water and Other Liquids
C500-80 & Correction	Gate Valves, 3 Through 48 In. NPS, for Water and Sewage Systems

C502-80 & Errata	Dry-Barrel Fire Hydrants
C503-82	Wet-Barrel Fire Hydrants
C504-80	Rubber-Seated Butterfly Valves
C600-82	Installation of Ductile-Iron Water Mains and Their Appurtenances
C601-81	Disinfecting Water Mains
C606-81 & C606a-83	Grooved and Shouldered Type Joints
C700-77	Cold Water Meters--Displacement Type
C701-78	Cold Water Meters--Turbine Type For Customer Service
C800-84	Underground Service Line Valves and Fittings

1.5 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Standard.

SP-80	Bronze Gate, Globe, Angle and Check Valves (1979)
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1.6 National Fire Protection Association (NFPA) Standards.

24-1984	Installation of Private Fire Service Mains and Their Appurtenances
49-1975	Hazardous Chemicals Data
325M-1984	Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids
704-1985	Identification of the Fire Hazards of Materials

2. GENERAL. This section covers water distribution service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required.

2.1 Piping for Water Service Lines. Piping for water service lines less than 3 inches in diameter shall be galvanized steel, or copper tubing, unless otherwise shown or specified. Piping for water service lines for sizes 3 inches and larger shall be ductile iron, centrifugally cast reinforced, or steel, unless otherwise shown or specified.

2.2 Piping for Water Distribution Lines 3 Inches or Larger. Piping for water distribution lines 3 inches or larger shall be ductile iron, centrifugally cast reinforced, or reinforced concrete, unless otherwise shown or specified. Piping for the irrigation is described in SECTION: IRRIGATION.

2.3 Recommendations of the Manufacturer. The Contractor shall, as a part of the shop drawings, submit to the Contracting Officer the manufacturer's recommendations for each material or procedure to be utilized which is required to be in accordance with such recommendations. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless otherwise directed by the Contracting Officer.

3. EXCAVATION, TRENCHING, AND BACKFILLING FOR WATER LINES. 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.

4. MATERIALS shall conform to the respective specifications and other requirements specified below.

4.1 Pipe.

4.1.1 Copper Tubing. ASTM B 88, Type K, annealed.

4.1.2 Ductile-Iron Pipe. AWWA C151, working pressure not less than 150 psi unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard.

4.1.3 Reinforced and Prestressed Concrete Pipe. Steel-cylinder reinforced concrete pipe shall conform to AWWA C300, C301, or C303 and shall be designed to withstand a working pressure of not less than 150 psi unless otherwise specified or indicated.

4.1.4 Steel Pipe 3 inches and Larger, not Galvanized. AWWA C200 with dimensional requirements as given in ANSI B36.10 for pipe 6 inch in diameter and larger, and ASTM A 120 for smaller sizes. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 ends for use with mechanical couplings or bell-and-spigot ends with rubber gaskets. Bell-and-spigot ends for sizes less than 6-inch diameter shall be as required by AWWA C200.

4.1.5 Galvanized-Steel Pipe, Less than 3 Inches. ASTM A 120, standard weight.

4.1.6 Protective materials for steel pipe, except as hereinafter specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following for the indicated pipe material and size.

4.1.6.1 Galvanized-Steel Pipe Less Than 3 Inches. Steel pipe and fittings less than 3 inches in diameter shall be thoroughly cleaned of foreign material by wire brushing and solvent cleaning, and then given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203, threaded ends of pipe and fittings shall be adequately protected prior to coating.

4.1.6.2 Pipe 3 Inches or Larger, not Galvanized.

4.1.6.2.1 Cement-mortar coating and lining shall conform to and shall be applied in conformity with AWWA C205. Cement-mortar coating and lining shall not be used for pipe less than 4 inches in diameter.

4.1.6.2.2 Coal-tar enamel lining, coating and wrapping shall conform to AWWA C203 for materials, method of application, tests and handling. Pipe shall be coated with coal-tar primer followed by a hot coat of coal-tar enamel, a wrapper of asbestos felt impregnated with coal tar, and a wrapper of kraft paper or a coat of water-resistant whitewash.

4.1.6.2.3 Cement-mortar lining, in lieu of coal-tar enamel lining, may be used with coal-tar enamel coating and wrapping. Cement-mortar lining shall conform to and shall be applied in conformity with AWWA C205.

4.2 Joints.

4.2.1 Copper Tubing. Joints shall be compression-pattern flared and shall be made with fittings hereinafter specified.

4.2.2 Ductile-Iron Pipe.

4.2.2.1 Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

4.2.2.2 Push-on joints shall conform to AWWA C111.

4.2.2.3 Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

4.2.3 Reinforced Concrete Pipe. Rubber-gasket joints shall be of the type using a bell-and-spigot joint design of steel. The gaskets shall conform to AWWA C300, C301, or C303, as applicable.

4.2.4 Steel Pipe, not Galvanized.

4.2.4.1 Mechanical couplings shall be as hereinafter specified.

4.2.4.2 Bell-and-spigot joints for use with rubber gaskets shall conform to AWWA C200, as appropriate for the type of pipe. Rubber gaskets shall conform to applicable requirements of AWWA C200.

4.2.4.3 Flanges shall conform to AWWA C207, and shall be used only in above ground installations or where shown on the drawings or when approved.

4.2.5 Bonded Joints. Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings, calking, or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond wire shall be Type RHW-USE, Size 1/0 neoprene-jacketed copper conductor shaped to stand clear of the joint. The bond shall be of the thermal weld type.

4.2.6 Insulating joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Insulating joints shall consist of a sandwich-type flange insulating gasket of the dielectric type, insulating washers, and insulating sleeves for flange bolts. Insulating gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt insulating sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

#### 4.3 Fittings and Specials.

4.3.1 For Copper Tubing. Fittings and specials shall be flared and conform to ANSI B16.26.

4.3.2 For Ductile-Iron Pipe. Fittings and specials shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard thickness.

4.3.3 For Reinforced Concrete Pipe. Fittings and specials required for closures, curves, bends, branches and connections to valves, pipe, or structures shall be approved by the Contracting Officer and conform to the details furnished by the manufacturer and to AWWA C300, C301, or C303 as applicable.

4.3.4 For Steel Pipe 3 Inches and Larger, not Galvanized. Fittings and specials shall be made of the same materials as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Dimensions of steel-pipe fittings shall be in accordance with AWWA C208. The thickness and pressure rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same materials as are used for the pipe with the same number of applications of each material carefully and smoothly applied.

4.3.5 For Galvanized-Steel Pipe Less Than 3 Inches. Steel fittings shall be galvanized. Screwed fittings shall conform to ANSI B16.3. Flanged fittings shall conform to AWWA C207. Dresser-type fitting shall be suitable for use with type of pipe furnished.

4.3.6 Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

#### 4.4 Couplings.

4.4.1 Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction,

slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

4.4.1.1 Sleeve-type couplings shall be used for joining plain end pipe sections. The couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

4.4.1.2 Split-sleeve-type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

#### 4.5 Valves.

4.5.1 Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturers name, initials, or trademark shall be cast on the body of each valve.

4.5.1.1 Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

4.5.1.2 Valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends, and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI B16.1.

4.5.2 Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

4.5.2.1 Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

4.5.2.2 Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

4.5.3 Rubber-Seated Butterfly Valves. Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 must be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal.

Mechanical-end valves 3- through 10-inch in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

4.5.4 Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 120 psi operating pressure on the inlet side, with outlet pressure set for 80 psi. The valves shall be of the hydraulically operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm operated, adjustable, spring loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

4.5.5 Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

4.5.6 Indicator Post for Valves. Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA No. 24. Operation shall be by wrench. One wrench shall be provided for valve operation.

4.6 Valve Boxes. Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

4.7 Valve Pits. Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown. Concrete shall have compressive strength of 3000 psi in accordance with SECTION: CONCRETE FOR BUILDING AND RETAINING WALL CONSTRUCTION.

4.8 Miscellaneous Items.

4.8.1 Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable iron body with cadmium plated straps and nuts. Clamps shall have rubber gasket cemented to the body. Clamp sizes are specified at the end of this section.

4.8.2 Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks. Corporation stop sizes are specified at the end of this section.

4.8.3 Goosenecks. Lead pipe for gooseneck connections shall conform to the applicable requirements of Fed. Spec. WW-P-325, Class 100. Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirements connections shall be in accordance with standard practice.

4.8.4 Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

4.8.5 Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 200 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets, and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in the pipe, encasing an elastometric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 pound feet.

4.8.6 Service boxes shall be cast iron or concrete. Extension service boxes of the required length and having either screw or slide-type adjustment shall be installed at all service box locations. The boxes shall have housings of sufficient size to completely cover the service stop and shall be complete with identifying covers.

4.8.7 Disinfection. Chlorinating materials shall conform to the following.

Chlorine, Liquid. AWWA B301.

Hypochlorite, Calcium and Sodium. AWWA B300.

4.8.8 Meters shall be of the displacement type conforming to AWWA C700 or turbine type conforming to AWWA C701. Registers may be round or straight reading type. Connection to the water line shall be as required for the particular installation. All meters used for the same system shall be of one type and manufacturer.

4.8.9 Meter boxes shall be of cast iron or concrete of sufficient size to completely enclose the meter and shut-off valve or service stop. Box height shall extend from invert of the meter to final grade at the meter location. Cover shall be cast iron with the word "WATER" cast in it.

## 5. INSTALLATION.

5.1 Handling. Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense

in a satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for alining or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place. Storage facilities shall be classified and marked in accordance with NFPA No. 704, with classification as indicated in NFPA No. 49 and NFPA No. 325M.

5.1.1 Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

5.2 Cutting of Pipe. Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

### 5.3 Adjacent Facilities.

5.3.1 Sewer Lines. Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

5.3.2 Water lines, excluding irrigation lines, shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

5.3.3 Copper tubing shall not be installed in the same trench with ferrous piping materials.

5.3.4 Nonferrous Metallic Pipe. Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

5.3.5 Roads. Water pipe shall be encased in a sleeve of rigid conduit and shall extend 12 inches beyond edges of pavement. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding

shall be provided for the water pipe through the sleeve. Sleeves of ferrous material shall be provided with corrosion protection as required for the conditions encountered at the site of installation.

5.3.6 Structures. Where water pipe is required to be installed within three feet of existing structures the water pipe shall be sleeved as required for roads. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure that there will be no damage to the structures and no settlement or movement of foundations or footings. Any damage occurring as a result of the Contractor's operation shall be corrected and all costs connected therewith shall be borne by the Contractor.

#### 5.4 Joint Deflection.

5.4.1 Ductile-Iron Pipe. The maximum allowable deflection will be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

5.4.2 Reinforced Concrete Pipe. Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, will be 5 degrees for reinforced concrete pipe unless a lesser amount is recommended by the manufacturer. Long radius curves in reinforced concrete pipe shall be formed by straight pipe in which spigot rings are placed on a bevel. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflections does not exceed the maximum recommended by the pipe manufacturer. Short-radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated specials specified hereinbefore.

5.4.3 Steel Pipe. For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified hereinbefore.

5.5 Placing and Laying. Pipe and accessories shall be carefully lowered into the trench by means of ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joining is completed. When work is not in progress, open ends, of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

5.5.1 Reinforced concrete pipe shall be installed in accordance with recommendations of the pipe manufacturer. Before laying reinforced concrete pipe, the outside surface of the spigot and the inside surface of the bell shall be cleaned and an acceptable vegetable-compound lubricant applied to the inside surface of the bell and to the rubber gasket. Where prescribed by the pipe manufacturer, the gasket shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gauge in accordance with the pipe manufacturer's recommendations.

5.5.1.1 Tapping of reinforced concrete cylinder pipe shall be done in accordance with the manufacturer's approved recommendations. Where the manufacturer recommends that the taps be made by attaching the rubber-gasketed saddle to the outside of the pipe using U-bolts, the saddle shall be grouted in if necessary, the mortar coating shall be chipped away even with the hole in the saddle plate. The exposed circumferential wires shall be removed and the cylinder and concrete core drilled out, and the steel saddle and U-bolts shall be protected by concrete encasement.

5.5.2 Connections. Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. Standard methods are available for making connections to various types of pipe, either under pressure or in the dewatered condition. Where made under pressure, these connections shall be installed as approved by the Contracting Officer.

5.5.3 Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

## 5.6 Jointing.

5.6.1 Copper Tubing. Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

5.6.2 Ductile-Iron Pipe. Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

5.6.3 Reinforced-Concrete Pipe. The inside and outside annular spaces between abutting sections of concrete pipe shall be filled with rich cement mortar in accordance with the recommendations of the pipe manufacturer. Care shall be taken to insure that excess mortar will be removed from interior annular spaces, leaving a smooth and continuous surface between pipe sections. Exposed portions of steel joint rings shall be protected from corrosion by a metallic coating or by an approved nonmetallic coating. Rubber gaskets shall be handled, lubricated where necessary and installed in accordance with the recommendations of the pipe manufacturer.

5.6.4 Steel Pipe, not Galvanized.

5.6.4.1 Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

5.6.4.2 Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the pipe manufacturer.

5.6.5 Galvanized-Steel Pipe. Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

5.6.6 Bonded joints shall be installed in accordance with details specified for joints under paragraph: MATERIALS.

5.6.7 Dielectric fittings shall be installed in accordance with details specified for joints under paragraph: MATERIALS. Dielectric unions shall be encapsulated in a field poured coal-tar covering, with at least 1/8-inch thickness of coal tar over all fitting surfaces.

5.6.8 Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

5.7 Service Lines. Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with extension service boxes of the lengths required. Service lines shall be constructed in accordance with the following requirements.

5.7.1 Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp. A corporation stop and a copper gooseneck shall be provided with either type of connection. Maximum sizes for directly-tapped corporation stops and for outlets with service clamps shall be as in Table I.. Where two or more gooseneck connections to the main are required for an individual service, such connections shall be made with standard branch connections. The total clear area of the branches shall be at least equal to the clear area of the service which they are to supply.

5.7.1.1 Service lines 1-1/2 inches and smaller shall have a service stop.

5.7.1.2 Service lines 2 inches in size shall have a gate valve.

5.7.2 Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve. Three-inch and larger lines may use rubber-seated butterfly valves as specified above, or gate valves.

## 5.8 Field Coating and Lining of Pipe.

### 5.8.1 Steel Pipe 3 Inches and Larger, not Galvanized.

5.8.1.1 Cement-Mortar Coating and Lining. Field jointing shall conform to Appendix, AWWA C205. Any defective area found in the coating and/or lining of pipe and joints shall be removed to the pipe wall, and the area shall be repaired in a manner such that the repaired areas will be at least equal in thickness to the minimum coating and/or lining required for the pipe. Steel reinforcement in the coating shall be repaired or replaced as necessary to assure a complete and soundly reinforced coating.

5.8.1.2 Coal-Tar Enamel Coating, Lining and Wrapping. Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating and/or lining required for the pipe.

5.8.2 Galvanized-Steel Pipe. Field joints shall be given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to AWWA C203, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating required for the pipe.

### 5.9 Setting of Valves and Valve Boxes.

5.9.1 Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or the the undisturbed trench face if less than 4 feet.

5.9.2 Valves, after delivery, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrant or valve shall be fully opened and fully closed to insure that all parts are in working condition.

5.9.3 Service Boxes. Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

5.9.4 Vacuum and air relief valves shall be installed in valve pits as shown.

5.10 Tapped Tees and Crosses. Tapped tees and crosses for future connections shall be installed where shown.

5.11 Thrust Blocks. Plugs, caps, tees and bends deflecting 22-1/2 degrees or more, either vertically or horizontally, on water-lines 6 inches in diameter or larger, and fire hydrants shall be provided with thrust blocking, or metal tie

rods and clamps or lugs, as directed. Valves shall be securely anchored or shall be provided with thrust blocking to prevent movement. Thrust blocking shall be concrete of a mix not leaner than 1 cement. 2-1/2 sand. 5 gravel, and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps shall be protected by galvanizing or by coating with bituminous paint.

6. HYDROSTATIC TESTS. Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking unless otherwise approved. The method proposed for disposal of waste water from hydrostatic tests and disinfection shall be submitted by the Contractor to the Contracting Officer for approval prior to performing hydrostatic tests.

6.1 Pressure Test. After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for one hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered.

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkway around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the contract.
- d. An unforeseeable cause which would result in excess cost.

The Contractor may request the waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

6.2 Leakage Test. Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the

newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula.

$$L = 0.0001351ND(P \text{ raised to } 1/2 \text{ power}) \text{ for pipes.}$$

In which L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in psi gauge.

Should any test of pipe disclose leakage greater than that specified in the foregoing table, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

6.3 Time for Making Test. Except for joint material setting or where concrete reaction backing necessitates a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

6.4 Concurrent Hydrostatic Tests. The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

6.4.1 Pressure test and leakage test may be conducted concurrently.

6.4.2 Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

7. DISINFECTION. Before acceptance of potable water operation, each unit of completed water line shall be disinfected as specified herein. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph: MATERIALS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period.

All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, the Contracting Officer will take samples of water in proper sterilized containers for bacterial examination. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

8. CLEANUP. Upon completion of the installation of the water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

TABLE I. SIZE OF CORPORATION STOPS AND OUTLETS

<u>Pipe Size Inches</u>	<u>Corporation Stops, Inches For Ductile-Iron Pipe</u>	<u>Outlets w/Service Clamps, Inches Single &amp; Double Strap</u>
3	-----	1
4	1	
6	1-1/4	1-1/ 2
8	1-1/2	2
10	1-1/2	2
12 & larger	2	2

\* \* \* \* \*

SECTION 2H

AGGREGATE BASE COURSE

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- |                                      |                                 |
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| 6. Weather Limitations               | 14. Thickness Control           |
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1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) Standards 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.

C 117-84	Materials Finer than No. 200 (75-M) 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 131-81	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
C 136-84	Sieve or Screen Analysis of Fine and Coarse Aggregates
D 75-82	Sampling Aggregates
D 422	Method for Particle-Size Analysis of Soils
D 1556-82	Density of Soil In Place by the Sand-Cone Method
D 1557-70	Moisture-Density Relations of Soils, Using 10-lb. (4.5-kg) Rammer and 18-in. (457-mm) Drop
D 2216-80	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures

2. MATERIALS. Aggregates shall consist of crushed stone, crushed gravel, angular sand, soil, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. It shall be the responsibility of the Contractor to obtain materials that will meet the requirements specified herein and that can be constructed to meet the grade and smoothness requirements specified herein after all compaction requirements have been completed. The material retained on a No. 4 sieve shall be known as coarse aggregate, and the material passing the No. 4 sieve shall be known as binder material.

2.1 Coarse Aggregate conforming to the requirements specified above shall have a percentage of wear not to exceed 50 percent after 500 revolutions. Coarse aggregate shall consist of angular fragments reasonably 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.

2.1.1 Coarse aggregate 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.

2.2 Binder Material shall consist of screenings, angular sand, soil, or other finely divided mineral matter processed or naturally combined with the coarse aggregate. Liquid-limit and plasticity-index requirements stated herein shall apply to any component that is blended to meet the required gradation and shall also apply to the completed course. 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.

2.3 Gradation requirements specified herein shall apply to the completed base course, and it shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. The aggregates shall be continuously graded within the limits specified below:

Sieve Designation	Percentage by Weight Passing Square-Mesh Sieve
1-1/4 inch	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12

The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

3. SAMPLING AND TESTING shall be by and at the expense of the Contractor.

3.1 Samples shall be the size required and shall be taken by the Contractor. Copies of test results shall be submitted for approval 7 days prior to starting the work, and thereafter at regular intervals during production as specified hereinafter. These samples shall be obtained at the source, from test pits, borings, trucks, stockpiles, or from other designated locations. Samples for material gradation, liquid-limit determination, and plasticity-index tests shall be taken in conformance with ASTM D 75. After the material has been placed and compacted, samples for density tests shall be taken as specified in ASTM D 1556 and additional samples for gradation, liquid-limit, and plasticity-index tests shall be taken by an appropriate method. Where deemed necessary, the sampling will be supervised by the Contracting Officer. The Contractor shall arrange his work so that sampling and testing may be performed without interruption.

3.2 Tests.

3.2.1 Aggregate Gradation. Aggregate gradation shall be determined in accordance with ASTM C 117, C 127, C 128, C 136, and D 422. Sieves shall conform to ASTM E 11.

3.2.2 Liquid Limit shall be determined in accordance with ASTM D 4318.

3.2.3 Plasticity Index shall be determined in accordance with ASTM D 4318.

3.2.4 Wear Test shall be made in conformance with ASTM C 131.

3.2.5 Field-In Place Density shall be determined in accordance with ASTM D 1556. The in place moisture content shall be determined in accordance with ASTM D 2216. Moisture-density relations shall be established in the laboratory in accordance with ASTM D 1557.

3.3 Testing Frequency. Results of tests to determine particle shape, presence of objectionable and foreign matter, percentage of wear, fracture count, gradation, liquid-limit, plasticity-index, specific gravity, and other specification requirements for determination of the acceptability of the source shall be submitted for approval at least 7 days prior to starting of manufacture of the base course material. Production testing for material gradation, liquid limit, and plasticity index shall be performed at regular intervals with at least one test being made for each 500 cubic yards or fraction thereof, of material produced and results shall be submitted on a daily basis. Deviations from specification requirements shall be corrected immediately upon discovery. After the material has been placed and compacted, one field density test for each 1,000 square yards or fraction thereof of finished base course and one additional gradation, liquid-limit, and plasticity-index test for each 3,000 square yards of base course or fraction thereof shall be performed. Maximum-density moisture relations shall be established for each 5,000 square yards of base course material. The location of the after-placement tests shall be as directed by Contracting Officer. One copy of density data (less dry weight determinations) shall be provided on the day each test is taken. The completed test report shall be provided with

the Contractor Quality Control Report on the following work day. Results of all tests made shall be submitted for approval on a daily basis and subsequent paving operations shall not commence until final approval has been obtained. Failure of any test shall be reported verbally, by the most expeditious means and followed promptly by written report. Contractor field operations shall immediately reflect corrective measures for every failing test. Retesting after completion of corrective measures have been taken will be required.

3.4 Approval of Materials. The source of the material shall be selected 7 days in advance of the time materials will be required in the work. Tentative approval of the preliminary reports submitted by the Contractor and the source will be based on an inspection by the Contracting Officer. Tentative approval of the materials will be based on test samples as specified herein. Final approval of both the source and the materials will be based on specified tests performed on samples taken from the completed and compacted base course.

4. EQUIPMENT. All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and have the capability of producing the required compaction, meeting grade controls, thickness controls, and smoothness requirements as set forth herein and within the specified time limits.

5. OPERATION OF PITS OR QUARRIES. All work involved in clearing, stripping, and excavating in opening or operation of pits or quarries shall be performed by the Contractor. Pits or quarries shall be opened to expose vertical faces of deposit to depths suitable for working. Materials excavated from pits shall be obtained in successive vertical cuts extending through all exposed strata. All pockets or strata of unsuitable materials overlying or occurring within the deposit shall be wasted as directed. The methods of operating pits or quarries and the processing and blending of the material may be changed or modified by the Contracting Officer when necessary to obtain material conforming to the specified requirements. Quarries shall be conditioned in agreement with the local laws or authorities.

6. WEATHER LIMITATIONS. Aggregate base courses shall be constructed when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F., the contractor shall protect all areas of the completed aggregate base course, by approved methods, against any detrimental effects of freezing. Areas of completed aggregate base course damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

7. PREPARATION OF UNDERLYING SURFACE. Prior to constructing the aggregate base course, the previously constructed subgrade shall be cleaned of all foreign substances. The surface of the subgrade shall be inspected by the Contractor for adequate compaction and surface tolerances. The subgrade shall conform to SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR STRUCTURES. Certification that the subgrade meets all requirements shall be supplied to the Contracting Officer's Representative, in writing, at least 24 hours prior to placing of the base course. Ruts or soft, yielding spots that may appear in the subgrade areas having inadequate compaction, and deviations of the surface from the requirements set forth therein shall be corrected to line and grade and to all specification requirements. The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

8. GRADE CONTROL. During construction, the lines and grades, including crown and cross slope indicated for the aggregate base course, shall be maintained by means of line and grade stakes placed by the Contractor at the worksite in accordance with paragraph: LAYOUT OF WORK of the SPECIAL CLAUSES.

9. MIXING AND PLACING MATERIALS. The 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 aggregate base course material and at a uniform optimum moisture content for compaction. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce to accelerate loss or increase of water, and to insure a satisfactory aggregate base course meeting all the requirements of this specification.

10. LAYER THICKNESS. The compacted thickness of the aggregate base course shall be as indicated. When a compacted layer of 6 inches or less is indicated, the material may be placed in a single layer. When a compacted layer thickness of more than 6 inches is indicated, the material shall be placed in two layers of approximately equal thickness.

11. COMPACTION. Each layer of the aggregate base course (including shoulders) shall be compacted with approved compaction equipment. In places not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of maximum density. The Contractor shall make such adjustments in rolling or finishing procedures as may be required to obtain true grades, to minimize segregation and degradation, to reduce or accelerate loss or gain of water, and to insure a satisfactory aggregate base course. Unsatisfactory materials shall be reworked to produce a satisfactory material.

12. EDGES OF BASE COURSE. Where the course is not placed between curbs or similar construction, approved material shall be placed along the edges of the aggregate base course in such quantities as will compact to the thickness of the course being considered. Allow in each operation at least a one-foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

13. SMOOTHNESS TEST. The surface of each layer shall not show any 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 paved area. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed.

14. THICKNESS CONTROL. The completed thickness of the base course shall be within 1/2 inch, plus or minus, of the thickness indicated. Thickness test shall be made and recorded by the Contractor. The thickness of the base course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of base course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the base course. Where the measured thickness of the base course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to the Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed.

Where the measured thickness of the base course is more than 1/2 inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated.

15. MAINTENANCE. The Contractor shall maintain the aggregate base course in a satisfactory condition until the completed work is accepted.

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SECTION 2I

PRIME COAT AND WEED KILLER

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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 1250-80	Petroleum Measurement Tables
D 2027-76 (R 1981)	Liquid Asphalt (Medium-Curing Type)

2. BITUMINOUS MATERIAL. The bituminous material for the prime coat shall be liquid asphalt, conforming to ASTM D 2027, designation MC-70.

3. SAMPLING AND TESTING.

3.1 Sampling. Samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140.

3.2 Testing shall be the responsibility of the Contractor. Testing shall be performed by an acceptable commercial testing laboratory or by the Contractor on approval of the Contracting Officer. Materials shall be tested to establish compliance with the specified requirements.

3.3 Certified Laboratory Test Reports. Before delivery of bituminous materials, certified copies, in triplicate, of the tests specified herein and in referenced publications shall be submitted to and approved by the Contracting Officer. The testing shall be performed by an independent laboratory approved by the Contracting Officer.

4. QUANTITY TO BE APPLIED. Bituminous material for the prime coat shall be applied in quantities of not less than 0.10 gallon nor more than 0.35 gallon per square yard of the surface to be primed. Application of prime coat shall be divided, if necessary, into 2 applications to avoid flowing off the surface. The exact quantities which may be varied to meet field conditions shall be determined by the Contractor and approved by the Contracting Officer.

5. WEATHER LIMITATIONS. The prime coat shall be applied only when the prepared surface is dry or contains moisture not exceeding quantity to permit uniform distribution and desired penetrations. Prime coat shall be applied only when the

ambient temperature is 50 degrees F. or above and the temperature has not been below 35 degrees F. for 12 hours immediately prior to application.

## 6. EQUIPMENT.

6.1 General. All equipment, tools, and machines, used in the performance of the work required by this section shall be subject to the approval and shall be maintained in satisfactory working condition.

6.2 Bituminous Distributor shall have pneumatic tires of such width and number than 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 gauges, volume-measuring devices, adequate heaters for heating the materials to the proper application temperature, a thermometer to show the temperature of the tank contents, and a hose attachment suitable for applying bituminous material to spots avoidably missed by the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

6.3 Heating Equipment for Storage Tanks. 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 to 200 degrees F. shall be fixed to the tank so that the temperature of the bituminous material may be read at all times.

6.4 Brooms and Blowers shall be of the power type and shall be suitable for cleaning prepared surfaces.

7. PREPARATION OF SURFACE. Immediately before applying the (weed killer and) prime coat, all loose material, dirt, clay or other objectionable substances 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 material, an inspection of the area to be treated shall be made by the Contractor to determine the fitness of the area to receive the material. The Contracting Officer shall be notified 24 hours in advance of application of the material. To assure a uniform spread of the material, the areas prepared for treatment, if excessively dry, shall be lightly sprinkled with water immediately before the application as directed.

8. WEED KILLER. A chemical weed killer shall be applied to all areas to receive prime coat prior to application of the prime coat. The weed killer shall be EPA-approved pre-emergent herbicide specifically formulated for the intended purpose and suitable for eradicating weed species found in the area. The weed killer shall have demonstrated satisfactory performance for a period of at least 3 years. Application methods and rates shall be as recommended by the manufacturer and submitted to the Contracting Officer in addition to a Certificate of Conformance for the weed killer.

9. APPLICATION OF BITUMINOUS MATERIAL. Immediately following the preparation of the surface, the bituminous materials shall be applied by means of a bituminous distributor. The bituminous material shall be applied at a pressure within the range of 25 to 75 pounds per square inch and in the amounts as directed. The bituminous material shall be so applied that uniform distribution is obtained at all points of the surface to be treated. Unless the distributor is equipped to obtain satisfactory results at the junction of the previous and subsequent application, building paper shall be spread on the surface of 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 all sprayers operated at full force on the surface to be treated. Immediately after the application, building paper shall be removed and destroyed. Spots unavoidably missed by the distributor shall be properly treated with bituminous material. Following the application of bituminous material, the surface shall be allowed to dry without being disturbed for a period of not less than 48 hours, or longer as necessary to attain penetration into the foundation course and evaporation of the volatiles from prime material. The Contractor shall furnish and spread enough approved sand to blot up effectively 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, fires, or flames other than heaters that are a part of the equipment shall be permitted in the vicinity of heating, distributing, or transferring operations of bituminous material.

9.1 Application Temperature shall be as directed and shall provide an application viscosity between 40 and 120 centistokes, kinematic, or 20 and 60 seconds, Saybolt-Furol. Application temperatures shall be between 120-190 degrees F. except that appropriate changes should be made when the ranges of viscosity are raised or lowered. The temperature-viscosity relationship shall be furnished to the Contracting Officer.

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SECTION 2J

ASPHALT CONCRETE

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- |                                     |  |
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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 Association of State Highway and Transportation Officials (AASHTO) Standard.

M 226-80

Viscosity Graded Asphalt Cement

1.2 American Society for Testing and Materials (ASTM) Standards.

C 117-84

Materials Finer Than No. 200  
(75 micron) 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 136-84a

Sieve or Screen Analysis of Fine and  
Coarse Aggregates

D 140-70  
(R 1981)

Sampling Bituminous Materials

D 242-70  
(R 1980)

Mineral Filler for Bituminous Paving  
Mixtures

D 977-84

Emulsified Asphalt

D 1559-82

Resistance to Plastic Flow of  
Bituminous Mixtures Using Marshall  
Apparatus

1.3 Military Standard.

MIL-STD-620A  
& Notice 1

Test Methods for Bituminous Paving  
Materials

2. DESCRIPTION. Asphalt concrete indicated as "A.C." shall consist of fine and coarse aggregates and mineral filler, if required, uniformly mixed with hot bituminous material, and placed and compacted on a prepared base course subgrade.

3. AGGREGATES shall consist of crushed stone, crushed or uncrushed gravel, screenings, sand, and mineral filler. Aggregates shall have a satisfactory service record in bituminous pavement construction. The source selected shall be approved by the Contracting Officer. Material passing the No. 200 sieve shall be known as mineral filler. Mineral filler shall conform to ASTM D 242. The combined aggregates and mineral filler shall meet the requirements of subsequent paragraphs entitled AGGREGATE GRADATION and COMPOSITION OF MIXTURE.

4. BITUMINOUS MATERIAL.

4.1 Bituminous material to be mixed with the mineral aggregates shall be asphalt cement conforming to AASHTO M226, viscosity grade AR-40 or AR-80, Table 3.

4.2 Bituminous material used for the tack coat shall be asphalt emulsion conforming to the requirements of ASTM D 977, Type RS-1.

5. SAMPLING AND TESTING.

5.1 Sampling. Samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140.

5.2 Testing shall be the responsibility of the Contractor. Testing shall be performed by an acceptable commercial testing laboratory or by the Contractor on approval of the Contracting Officer. Materials shall be tested to establish compliance with the specified requirements. Certificates of compliance shall be furnished.

5.3 Minimum Quality Control Testing. In addition to other tests specified elsewhere, the Contractor is required to perform the following tests on materials as specified hereinafter. At least one set of tests, as described below, shall be completed for each day's placement of asphalt.

5.3.1 Two tests for aggregate gradations for each 500 tons of aggregate produced.

5.3.2 One determination each for stability, flow, voids total mix, and voids filled with bitumen for every 500 tons of AC produced.

5.3.3 Sampling for determination of thickness and density. Not less than one test for each 500 square yards.

5.4 The Contractor shall replace the pavement where samples are removed at his expense. No payment will be made for an area of pavement deficient in composition, density, or thickness, until they are removed and replaced by the Contractor as directed by the Contracting Officer.

6. AGGREGATE GRADATION. The aggregate gradation as determined by ASTM C 117 and C 136 shall conform to the following.

Sieve Opening	Percentage By Weight Passing
	a.
1-inch	100
3/4-inch	97-100
1/2-inch	85-100
3/8-inch	70-90
No. 4	50-75
No. 8	35-65
No. 50	20-40
No. 200	2-8

#### 7. COMPOSITION OF MIXTURE.

7.1 Job-Mix Formula shall be submitted by the Contractor, and no bituminous mixture shall be manufactured until it has been approved. The formula will indicate the percentage of each sieve fraction of aggregate, percentage of asphalt, and temperature of the mixture as discharged from the mixer. The percentage of asphalt in the job-mix formula will be between 5.5 percent and 6.5 percent. Samples of the aggregates and asphalt shall be submitted for approval with the job-mix formula.

7.2 Test Properties of Bituminous Mixtures. The apparent specific gravity, as determined by ASTM C 127 and C 128, shall be used in computing the voids total mix and voids filled with bitumen, and the mixture shall meet the following requirements as determined by ASTM D 1559:

Test Property	50-Blow Compaction
Stability, minimum, pounds	500
Flow, maximum, 1/100-inch	20
Voids total mix, percent	3-5
Voids filled with bitumen, percent	75-85

7.3 Stripping of Aggregates. If the index of retained stability of the job-mix formula is less than 75 when tested in accordance with Method 104 of MIL-STD-620, the aggregates shall be rejected or treated by one of the following procedures:

(1) Addition of heat-stable additives to bitumen.

(2) Addition of hydrated lime, or other cementitious material containing free lime, as a portion of the mineral filler.

8. MIXING PLANT shall be a weigh-batch or continuous-mixing type approved by the Contracting Officer and operated so as to produce a mixture within the job-mix formula.

#### 9. OTHER EQUIPMENT.

9.1 Bituminous-Materials Spreaders shall be self-propelled, capable of producing a finished surface conforming to the smoothness requirements specified hereinafter. The use of a spreader that leaves indentations or other objectionable irregularities in the freshly-laid mix will not be permitted.

9.2 Blowers and Brooms shall be of the power type suitable for cleaning the surface to be paved.

9.3 Saw shall be of the power type, capable of rapidly cutting pavement and trimming joints and edges of pavement.

9.4 Small Tools available on the work shall consist of the following: rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heater for heating small tools, wood sandals and stilt sandals of standard type, and other small tools as may be required.

9.5 Steel-Wheel Rollers shall be self-propelled, 3-wheel (tricycle) and/or tandem type, weighing not less than 20,000 pounds each. The rollers shall have adjustable wheel scrapers, water tanks, and sprinkling apparatus to keep the wheels sufficiently wet to prevent the bituminous mixture from sticking to the wheels. Rollers shall be capable of reversing without backlash and shall be free from worn parts. Roller wheels shall not have flat or pitted areas or projections that will leave marks in the pavement.

9.6 Pneumatic-Tired Rollers shall be self-propelled and shall consist of 2 axles on which are mounted multiple pneumatic-tired wheels in such a manner that the rear group of wheels will not follow in the tracks of the forward group but are spaced to give essentially uniform coverage with each pass. Axles shall be mounted in a rigid frame provided with a loading platform or body suitable for ballast loading. Tires shall be smooth and capable of being inflated to at least 90 psi. Construction of roller shall be such that each wheel can be loaded to a minimum of 4,500 pounds.

10. TREATMENT OF UNDERLYING SURFACE. Prior to laying a bituminous course, the underlying surface shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, and hand brooms, as directed. The surface to be paved shall receive prime coat and weed killer conforming to the requirements of the SECTION: PRIME COAT AND WEED KILLER.

11. TRANSPORTATION OF BITUMINOUS MIXTURE. The bituminous mixture shall be transported from the mixing plant to the site in trucks having tight, clean, smooth bodies with a minimum coating of concentrated solution of hydrated lime and water to prevent adhesion of the mixture. Each load of mixture shall be covered with canvas or other suitable material to protect the mixture from the weather and to prevent loss of heat. Mixtures having temperatures greater than 350 degrees, mixtures having temperatures less than 235 degrees, or mixtures which form or show indications of moisture will be rejected. Hauling over freshly laid material will not be permitted.

12. PLACING. Contact surfaces of previously constructed pavement, curbs, manholes and other structures shall be sprayed with a thin coat of asphalt conforming to the requirements of paragraph: TACK COAT. The mechanical spreader shall be adjusted and its speed regulated so that the surface of the course being placed will be smooth and continuous without tears and pulling. The course will be of such depth that after compaction, the cross section, grade, and contour will be as indicated. In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Unless otherwise directed, placing shall begin on the high side of areas with a one-way slope or along the centerline of areas with a crowned section and shall be in the direction of the main traffic flow. Placing of the mixture shall be as continuous as possible, and the speed of placing shall be adjusted, as directed, to permit proper rolling.

13. COMPACTION OF MIXTURE shall be accomplished by steel-wheel and pneumatic-tired rollers. Rolling shall begin as soon after placing as the mixture will support the roller without undue displacement. Rolling of the course shall be continued until all roller marks are eliminated and at least 95 percent of the density of a laboratory specimen of the same mixture has been obtained. The speed of the rollers at all times shall be slow enough to avoid displacement of the hot mixture. The wheels of the roller shall be moistened to prevent adhesion of the mixture. In areas not accessible to the roller, the mixture shall be compacted with hot hand tampers.

14. TACK COAT.

14.1 Quantities to be Applied. Bituminous materials for the tack coat shall be applied in quantities of not less than 0.02 gallon nor more than 0.15 gallon per square yard. The exact quantities within the range specified may be varied to suit field conditions, as determined by the Contractor and approved by the Contracting Officer's Representative.

14.2 Equipment. All equipment, tools, and machines used in performance of work required by this section shall be subject to approval and shall be maintained in satisfactory working condition.

14.3 Weather Limitations. Tack coat shall be applied only when the surface to be treated is dry and the temperature shall not have been lower than 35 degrees F for 12 hours immediately prior to application. It shall not be applied when the atmospheric temperature in the shade is lower than 50 degrees F.

14.4 Preparation of Surface. Immediately before applying the tack coat, if 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 application of the tack coat, an inspection of the area to be treated will be made by the Contracting Officer to determine fitness of the area to receive the bituminous coating. That portion of surface prepared for immediate treatment shall be dry and in a satisfactory condition.

14.5 Application of Bituminous Material. Immediately following preparation of surface, the bituminous material shall be applied by a bituminous distributor at a temperature determined by the Contracting Officer, within the range of 75 to 130 degrees F. Under no circumstances shall emulsion be heated to a temperature greater than 140 degrees F or exposed to a temperature of less than 40 degrees F. The bituminous material shall be applied so that uniform distribution is obtained over all points of the surface to be treated. Lightly coated areas and spots missed by the distributor shall be properly treated with bituminous material. Following application of bituminous material, the surface shall be allowed to dry to a proper condition of tackiness to receive surfacing.

15. JOINTS. The joints between old and new pavements or between lanes of new work shall be constructed so as to insure uniform bond, texture, density, and smoothness as in other sections of the course. Edges of existing pavement shall be cut to straight, vertical surfaces. All contact surfaces of existing pavement shall be painted with a thin, uniform coat of tack coat.

16. PROTECTION OF PAVEMENT. After final rolling, no vehicular traffic shall be permitted on the pavement for at least 6 hours after rolling.

17. THICKNESS AND SURFACE REQUIREMENTS.

17.1 Thickness. The finished pavement shall not be less than 1/4 inch less than the thickness specified on the drawings. If the pavement is more than 1/4 inch less than the specified thickness the Contractor may either (1) remove the entire pavement thickness and replace it or (2) overlay the pavement with a minimum one inch overlay. If the Contractor elects to overlay the pavement a new mix design with a maximum nominal aggregate size of 3/8 inch which shall supply the same properties as listed under subparagraph: Test Properties of Bituminous Mixtures, as the original mixture proposed, will be prepared. This mix design shall be subject to all approvals and requirements of other bituminous mixtures as stated above. If the Contractor elects to use an overlay, he will be required to mill down the asphalt paving to achieve a flush surface on edges to which the pavement abuts any curb, gutter, or other structure. The Contractor shall prepare the surface to receive the overlay and apply a Tack Coat as described above. Such overlay shall be supplied by the Contractor to the Government at no additional cost.

17.2 The finished surface shall not vary more than 1/4 inch from a 10-foot straightedge. The straightedge shall be furnished by the Contractor. Defective areas shall be corrected by the Contractor at no additional cost to the Government.

18. WAYBILLS AND DELIVERY TICKETS. Copies of waybills or delivery tickets for asphalt concrete shall be submitted during the progress of the work. Before the final statement is allowed the Contractor shall file with the Contracting Officer certified waybills and/or certified delivery tickets for all material used in the construction of the pavement covered by this section of the specification.

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## SECTION 2K

### CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION

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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 Specifications (Fed. Spec.).

SS-S-1401C	Sealant, Joint, Non-Jet-Fuel- Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements
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CCC-C-467C	Cloth, Burlap, Jute (or Kenaf)
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1.2 American Association of State Highway and Transportation Officials (AASHTO) Publication.

M 73	Cotton Mats
M 224-68 (R 1974)	Protective Coatings for Portland Cement Concrete

1.3 American Society for Testing and Materials (ASTM) Publications.

C 31-85	Making and Curing Concrete Test Specimens in the Field
C 39-84	Compressive Strength of Cylindrical Concrete Specimens
C 94-84	Ready-Mixed Concrete
C 143-78	Slump of Portland Cement Concrete
C 150-85	Specification for Portland Cement
C 171-69 (R 1986)	Sheet Materials for Curing Concrete

C 172-82	Sampling Freshly Mixed Concrete
C 173-78	Air Content of Freshly Mixed Concrete by the Volumetric Method
C 231-82	Air Content of Freshly Mixed Concrete by the Pressure Method
C 309-81	Liquid Membrane-Forming Compounds for Curing Concrete
C 494-82	Specification for Chemical Admixtures for Concrete
C 882-7 <sup>a</sup> (R 1983)	Bond Strength of Epoxy Resin Systems Used with Concrete
D 638-84	Tensile Properties of Plastics
D 695-84	Compressive Properties of Rigid Plastics
D 1190-74 (1980)	Specification for Concrete Joint Sealer, Hot Poured Plastic Type
D 1751-83	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-84	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
D 1850-74 (R 1979)	Concrete Joint Sealer, Cold-Application Type
D 2628-81	Specification for Pre-formed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

1.4 Uniform Standard Specifications for Public Works Construction.

Maricopa Association of Governments (MAG)

1.5 U.S. Department of Agriculture.

Handbook 18 Soil Survey Manual

2. PLANT, EQUIPMENT, MACHINES, AND TOOLS.

2.1 General Requirements. Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the

required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

2.2 Straightedge. The Contractor shall furnish and maintain at the jobsite, in good condition one 10-foot straightedge for testing the concrete surface. The straightedge shall be made available for Government use. The straightedge shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, reinforced to insure rigidity and accuracy. Straightedge shall have handles to facilitate movement on the concrete surface.

2.3 Slip Form Equipment. Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass. The paver shall be capable of finishing the surface and edges so that a minimum amount of hand finishing is required, and shall have sufficient weight and power to handle the amount of concrete required for the specified full section width. The mechanisms for forming the concrete shall be easily adjustable in width and thickness. Horizontal alignment shall be referenced to a taut wire or string line. Vertical alignment shall be referenced to a taut wire or string line, to the surface of the underlying material, or to the surface of previously constructed pavement. The vibrators or tamping elements shall be automatically controlled so that they will stop when forward motion ceases.

### 3. SUBMITTALS.

3.1 Concrete Test Reports. Copies of all test reports for tests specified in paragraphs: CONCRETE and FIELD QUALITY CONTROL shall be submitted within 24 hours of the completion of the test.

3.2 Concrete Delivery Tickets. Copies of certified delivery tickets for all concrete used in the construction shall be submitted.

### 4. WEATHER LIMITATIONS.

4.1 Placing During Cold Weather. Concrete placement shall be discontinued when the air temperature reaches 40 degrees F and is falling. Placement may begin when the air temperature reaches 35 degrees F and is rising. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement shall be approved in writing. Approval shall be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

4.2 Placing During Warm Weather. The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 85 degrees F.

5. CONCRETE shall conform to the applicable requirements of SECTION: CONCRETE unless otherwise specified.

5.1 Concrete pavement shall have a minimum compressive strength of 2500 psi. The maximum size aggregate shall be 3/4 inches except where otherwise specified. Concrete shall have a slump of not more than 3 inches. The concrete mixtures shall have an air content of between 4 and 7 percent by volume. Air content shall be determined in accordance with ASTM C 173 OR ASTM C 231. ASTM C 231 shall be used with concrete and mortars made with relatively dense natural aggregates.

5.2 Curb and Gutter shall conform to the applicable requirements of MAG Uniform Standard Specifications for Public Works Construction, except as said specifications conflict with requirements herein.

5.3 Exposed Aggregate Materials.

5.3.1 Fine Aggregates shall be 3/8 inch to 1/2 inch in size; washed clean, pounded type; natural in color; and of same color throughout project.

5.3.2 Bedding Sand shall have a particle size of 0 to 3 mm with 30 percent at 3mm.

5.4 Color Admixture. Color admixture for concrete shall be the product of a manufacturer regularly engaged in the production of color admixtures for concrete, and shall have a history of at least 2 years of use of the material in a similar environment without substantial fading or deleterious effects on the structural qualities of the concrete. Color admixture must be capable of distributing the color evenly throughout the concrete without segregation or irregular concentrations of color.

5.4.1 Colored Concrete. Of the concrete described in this section, the salt finish concrete will be colored.

5.4.2 Test Panel. The Contractor shall place a test panel for the concrete surface type specified with a minimum dimension of 4 feet by 4 feet by 6 inches thick. The test panel shall be placed in the presence of the Contracting Officer, and the mix design shall conform in all respects to the mix proposed for use in the project. The concrete shall be finished, protected, and cured on site as approved by the Contracting Officer using methods proposed for use by the Contractor on the features of the project which will receive colored concrete. Only one half of the panel area will be cured with curing compound. The remaining portion will not be cured. The test panel shall not be protected from the effects of the sun while curing. Color comparisons as a basis for acceptance of color shall not be made in less than 14 days after placement of concrete for the test panel. Wetting of the concrete shall not be permitted within a period of 7 days prior to making color comparisons. No concrete shall be scheduled for placement within 30 days of construction of the test panel, and no concrete shall be placed prior to demonstrated compliance with the color requirements of these specifications. When, in the opinion of the Contracting Officer, the test

panel(s) do not conform to color requirements herein, the Contractor shall continue to place additional test panels at no cost to the Government until a final mix design has been developed that produces concrete conforming to color requirements herein. Approval of test panel color and mix design shall not relieve the Contractor from requirements of these specifications. The Contractor shall not remove the test panel until concrete work is complete. At completion of concrete work, the test panel shall be considered to be scrap material and disposed of in accordance with SECTION: GENERAL REQUIREMENTS.

## 6. CONCRETE CURING MATERIALS.

6.1 Impervious Sheet Materials. Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

6.2 Burlap. Burlap shall conform to Fed. Spec. CCC-C-467, or cotton mats conforming to AASHTO M-73.

6.3 Curing Compound. Curing compound shall conform to the requirements of ASTM C 309, Type 1-D.

## 7. JOINT FILLER STRIPS.

7.1 Contraction Joint Filler for Curb and Gutter. Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

7.2 Expansion Joint Filler, Premolded. Expansion joint filler, premolded, shall conform to ASTM D 1751, ASTM D 1752, or ASTM D 2628 3/8 inch thick, unless otherwise indicated.

8. FORM WORK shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating of concrete. Wood forms shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

8.1 Pavement Forms. Pavement forms shall be of a height equal to the full depth of the finished sidewalk.

8.2 Curb and Gutter Forms. Curb and gutter forms shall conform to applicable requirements of MAG Section 340 Uniform Standard Specifications for Public Works Construction.

9. SUBGRADE PREPARATION. The subgrade shall be constructed to grade and cross section.

9.1 Concrete Sidewalk Subgrade. The subgrade shall be thoroughly wetted and then compacted with two passes of a 500-pound roller. Yielding material deflecting more than 1/2 inch under the specified roller shall be removed to a depth of not less than 4 inches below subgrade elevation and replaced with an approved granular material. The material shall then be compacted as described above. The completed subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

9.2 Concrete Walk Subgrade. Subgrade preparation for the concrete walk shall conform to the applicable requirements of paragraph: SUBGRADE PREPARATION of SECTION: EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES.

9.3 Curb and Gutter Subgrade. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement and shall be placed and compacted to conform with applicable requirements of MAG Uniform Standard Specifications for Public Works Construction.

9.4 Maintenance of Subgrade. The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

9.5 Slope Protection. The subgrade shall be scarified to a depth of 6 inches and soil amendments added as per SECTION: CACTI, TREES, SHRUBS, GROUND COVERS, VINES AND NATIVE ROCK. Fine grade and apply roller pressure to establish moderate compaction.

## 10. FORM SETTING.

10.1 Pavement. Forms for pavement shall be set with the upper edge true to line and grade and shall be held rigidly in place by stakes placed at intervals not to exceed 4 feet. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the channel center line. Forms shall be coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed. Side forms shall not be removed for less than 12 hours after finishing has been completed.

10.2 Curbs and Gutters. Forms shall be set to MAG Uniform Standard Specifications for Public Works Construction.

## 11. CONCRETE PLACEMENT AND FINISHING.

11.1 Pavement Concrete. Concrete shall be placed in the forms in one layer of such thickness that when compacted and finished the pavement will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be tamped and consolidated with a suitable wood or

metal tamping bar, and the surface shall be finished to grade with a wood float. Finished surface of the walk shall not vary more than 3/16 inch from the testing edge of a 10 foot-straightedge. Irregularities exceeding the above shall be satisfactorily corrected. The surface shall be divided into rectangular areas by means of contraction joints spaced not more than 5 feet on center, and by expansion joints spacers not more than 30 feet on center.

11.1.1 Sample panels. Construct one sample panel 36 inches square for each of the following concrete finishes: Exposed Aggregate Finish and Salt Finish for approval by the Contracting Officer prior to beginning the work.

11.1.2 Concrete Finishing. After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished as called out on plans free of waves, irregularities, or tool marks.

11.1.2.1 Broom Finish. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.

11.1.2.2 Exposed Aggregate Finish. Immediately after removal of form work, wash concrete surfaces with water and scrub with stiff bristle brush exposing aggregate to match accepted sample panel. Do not expose more than 40 percent of aggregate surface.

11.1.2.3 Salt Finish. Immediately after troweling rock salt shall be broadcast over surface and rolled or pressed into the surface so only the tops of the crystals are exposed. After the concrete has hardened wash surface and brush to dislodge salt grains. The salt distribution should be between one inch to 1-1/2 inches apart in sizes ranging from 1/4 to 3/8 inch.

11.1.3 Edge and Joint Finishing. All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 1/8 inch. Transverse joints shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corner and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

11.1.4 Contraction Joints. The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the pavement slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. The time of sawing shall be varied, depending on existing and anticipated weather conditions, and such sawing shall be at the required rate. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

11.1.5 Expansion Joints. Transverse expansion joints shall be installed at pavement returns and opposite expansion joints in adjoining curbs and as indicated on plans. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Transverse expansion joints shall be filled with 1/2 inch joint filler strips. Joint filler shall be placed

with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. Expansion joints shall be formed about structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated. The filler shall be installed in such manner as to form a complete, uniform separation between the structure and sidewalk pavement. At the end of the curing period, expansion joints shall be carefully cleaned and filled with joint sealer. Concrete at the joint shall be above 50 degrees F at the time of application of joint-sealing materials. Joints shall be filled flush with the concrete surface in such manner as to minimize spilling on the pavement surface. Spilled sealing material shall be removed immediately and the surface of the walk cleaned. Dummy groove joints shall not be sealed.

11.1.6 Surface Uniformity. The completed surface shall be uniform in color and free of surface blemishes and tool marks unless otherwise specified.

11.2 Curb and Gutter Concrete shall conform to MAG Uniform Standard Specifications for Public Works Construction.

11.3 Curb-Forming Machines. Curb-forming machines for constructing curb and gutter will be approved based on trial use on the job. Use of the equipment shall be discontinued at any time during construction if the equipment produces unsatisfactory results, and the work shall be accomplished as specified above. Unsatisfactory work shall be removed and reconstructed for the full length between regularly scheduled joints. Removed portions shall be disposed of as directed.

11.4 Slope Protection. Level subgrade 6 inches below finish grade. Place welded wire mesh 2 to 3 inches above subgrade and place forms as recommended by the manufacturer. Concrete shall be placed in the forms in one monolithic layer of such thickness that when compacted and finished the slope protection will be 5-1/2 inches thick. Finished surface shall not vary more than 1/2 inch from testing edge of a 10 foot-straightedge. Irregularities exceeding the above shall be satisfactorily corrected. The surface shall be broom finished. Coordinate work with irrigation and landscaping requirements.

11.5 Color. Color of pigmented concrete shall be considered satisfactory based in the comparative analysis of color produced from test panel(s) in accordance with paragraph: Test Panel, and Munsell color samples in accordance with U.S. Department of Agriculture Handbook 18 - Soil Survey Manual. Color of concrete shall conform to Munsell color number 10YR5/3 with respect to hue, value, and chroma. Evaluation of color shall be made within the time limits prescribed in subparagraph: Test Panel.

## 12. CURING AND PROTECTION.

12.1 Curing. Immediately after the finishing operations, exposed concrete surfaces shall be cured by one of the following methods as the Contractor may elect.

12.1.1 Mat Method. The entire exposed surface shall be covered with two or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be

kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

12.1.2 Impervious Sheeting Method. The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18 inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or by placing a bank of moist earth along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

12.1.3 Membrane-Curing Method. The entire exposed surface shall be covered with a membrane-forming curing compound. Where type 2 curing compound is used, the concrete surface shall be shaded from the direct rays of the sun during the curing period. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat to all surfaces showing discontinuity, pinholes or other defects. Concrete surfaces that are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by the above method and at the above coverage at no additional cost to the Government. Expansion-joint openings shall be sealed at the top by inserting moistened paper or fiber rope or covering with strips of waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action that might disrupt the continuity of the membrane. Any area covered with curing compound and damaged by subsequent construction operations within the 7-day curing period shall be resprayed as specified above at no additional expense to the Government.

12.2 Backfilling. After curing, debris shall be removed, and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

12.3 Protection. Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

13. SEALING JOINTS. The approximately horizontal sections of expansion joints and the top 1-inch depth of contraction-joint openings of gutter shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F

at the time of application of joint-sealing materials. Excess material on exposed surfaces of the concrete shall be removed immediately and exposed concrete surfaces cleaned.

#### 14. FIELD QUALITY CONTROL.

14.1 General Requirements. The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

#### 14.2 Concrete Testing.

14.2.1 Strength Testing. The Contractor shall provide molded concrete specimens for strength tests in accordance with ASTM C 39. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards or fraction thereof of concrete for each classification of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of two test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

14.2.2 Air Content. Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

14.2.3 Slump Test. Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests will be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noticed along the edges of slip-formed concrete.

14.3 Grade Conformance Tests. Completed pavement and curb and gutter sections will be checked for conformance with plan grade requirements. For that purpose the completed section will be subdivided into segments of length equivalent to the areas of the adjacent pavement. The finished surface of pavement shall be tested by running a line of levels at intervals of 25 feet or less, longitudinally along the centerline. Curb and gutter sections shall be tested by running a line of levels at 25-foot intervals or less. Curb and gutter elevations shall be recorded for edge of gutter, face of curb/flow line of gutter, and top of curb. The levels required will be run by the Contractor. Within 30 days after completion of

concrete placement in the respective area, the Contractor will furnish a copy of the level notes to the Contracting Officer, and identify in writing, all areas defective in plan grade requirements. No pavement shall be placed adjacent to a defective curb and gutter section until such time as the defect is corrected.

14.4 Surface Smoothness Determination. After the concrete has hardened sufficiently to permit walking thereon, but no later than 36 hours after placement, the surface of the completed section shall be tested by the Contractor, in the presence of the Contracting Officer, with a 10-foot straightedge or other approved device, operated in such a manner as to reveal all surface irregularities exceeding the specified tolerances. The entire area of pavement shall be tested in both the longitudinal and the transverse direction on longitudinal parallel lines 3 feet apart or less and transverse lines 10 feet apart or less. Curb and gutter shall be tested in the longitudinal direction along the center of the gutter and top of curb. The straightedge shall be held in contact with the surface and moved ahead  $1/2$  the length of the straightedge for each successive measurement. Straightedge lines shall be carried continuously across joints. The height of high areas on pavement surfaces shall be determined by placing the center of the straightedge at the center of high areas, rocking the straightedge until one end comes in contact with the pavement, then measuring the distance between the pavement surface and the bottom of the straightedge at the opposite end, and taking one-half the distance as the height of the high area. Other devices that reveal surface irregularities exceeding specified tolerances may be used when approved.

14.5 Edge Slump Determination. After the concrete has hardened sufficiently to permit walking thereon, the surface shall be tested with a 10-foot straightedge or other approved device to reveal irregularities exceeding the edge slump requirements. The edge slump shall be determined at each edge of each sidewalk or curb and gutter constructed. Measurements shall be made at 5- to 25-foot spacing commencing at the header where paving is initiated. The measurements shall be made by the Contractor, in the presence of the Contracting Officer, and will be properly referenced in accordance with established paving lane identification of the adjacent slab and stationing.

14.6 Thickness Evaluation. The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

14.7 Surface Evaluation. The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks unless otherwise specified.

## 15. SURFACE DEFICIENCIES AND CORRECTIONS.

15.1 Thickness Deficiency. When measurements indicate that the completed concrete section is deficient in thickness by more than 0.25 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

15.2 High Areas. In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours

old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. All pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

15.3 Excessive Edge Slump. High areas revealed by the edge slump measurements will be subject to the tolerances specified. The concrete within the limits of excessive edge slump will be removed and replaced. Partial slabs removed and replaced shall extend across the full width of the section.

15.4 Appearance. Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

16. REMOVAL AND REPLACEMENT OF DEFECTIVE CONCRETE. Defective or damaged concrete shall be removed and replaced as specified herein, and a method of curing shall be employed as directed. All removed concrete shall be replaced with concrete of the thickness and quality required by these specifications. In no case shall the removal and replacement of concrete result in a slab less than the full sidewalk or curb and gutter width or a joint less than 5 feet from a regularly scheduled transverse joint. The defective concrete shall be removed carefully so that the adjacent section is not damaged. When a portion of the unfractured slab is replaced, a full depth saw cut shall be made transversely across the slab in the required location, and the concrete shall be removed to provide a vertical face in the remaining portion of the slab. Prior to placement of the fresh concrete, the face of the slab shall be cleaned of debris and loose concrete. Transverse joints of the replaced slab or portion thereof shall be constructed as indicated. The joints shall be sealed as specified. Removal and replacement of defective or damaged concrete shall be accomplished by the Contractor at no additional cost to the Government.

17. EPOXY BONDING. Prior to placement of concrete on existing concrete or grouted stone or grouted stone on existing concrete or grouted stone, epoxy-resin grout for bonding shall be applied as stated hereinafter.

17.1 Material. Epoxy-Resin Grout shall be a 2-component, epoxy-resin system suitable for bonding fresh concrete to hardened concrete. Epoxy-resin system shall also be suitable for use in either damp or dry conditions, shall remain serviceable in temperatures ranging from 0 degrees to 120 degrees F., and shall have a compressive strength of not less than 9,000 psi in 7 days, bond strength of not less than 1,900 psi in 14 days, and tensile strength of not less than 8,700 psi when tested in accordance with the following applicable American Society for Testing and Materials Standards: C 882, D 638, and D 695.

17.2 Installation.

17.2.1 Surface Preparation. Surfaces of concrete shall be cleaned by abrasive blast methods, sweeping, and blowing with compressed air.

17.2.2 Bonding Course. The clean surface shall then be coated with a 20- to 40-mil-thick film of epoxy-resin grout. The epoxy-resin grout shall be placed in one application, just prior to grouted stone placement, with the use of mechanical combination mixing and spraying equipment, or shall be applied in two coats with stiff brushes. The first brush coat shall be scrubbed into the concrete surface, followed by an additional brush coat to obtain the required thickness. When the brush method is used, the initial coat may be allowed to dry; however, the final coat shall be applied just prior to placement of concrete.

17.2.2.1 Epoxy-resin grout components shall be mixed in the proportions recommended by the manufacturer. The components shall be kept at 70 degrees F to 85 degrees F for 48 hours prior to mixing. The two epoxy components shall be mixed with a power-driven explosion-proof stirring device in a metal or polyethylene container having a hemispherical bottom for the mixing vessel. The curing agent component shall be added gradually to the epoxy-resin component with constant stirring until a uniform mixture is obtained. The rate of stirring shall be such that the entrained air is a minimum.

17.2.2.2 Tools and equipment used further in the work shall be thoroughly cleaned before the epoxy-resin grout sets.

17.2.3 Time of Placement of Concrete Overlay. The placement of the concrete or grouted stone shall be completed while the epoxy-resin grout is still tacky.

17.2.4 Health and Safety Precautions.

17.2.4.1 Full face shields shall be provided for all mixing and blending operations and for placing operations as required.

17.2.4.2 Protective coveralls and neoprene-coated gloves shall be provided for all workmen engaged in the operations.

17.2.4.3 Protective creams of a suitable nature for the operations shall be supplied.

17.2.4.4 Adequate fire protection shall be maintained at all mixing and placing operations.

17.2.4.5 Smoking or the use of spark- or flame-producing devices shall be prohibited within 50 feet of mixing and placing operations.

17.2.4.6 The mixing, placing, or storage of epoxy-resin grout or solvent shall be prohibited within 50 feet of any vehicle, equipment, aircraft, or machinery that could be damaged from fire or could ignite vapors from the material.

18. PLACING. Concrete footings and exterior slabs shall be placed upon clean undisturbed surfaces free from frost, ice, and water. Dry or pervious surfaces receiving concrete shall be covered with impervious sheet materials. Concrete may be placed directly on impervious surfaces that are thoroughly moistened but not muddy. Concrete shall be placed in layers not over 12 inches deep. Concrete shall be protected from freezing. Concrete to receive other construction shall be screeded to the proper level.

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SECTION 2L

STONE PROTECTION

Index

- 1. Applicable Publications
- 2. Materials
- 3. Foundation Preparation

1. APPLICABLE PUBLICATIONS. The following American Society for Testing and Materials Standards 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.

C 88-83	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 127-84	Specific Gravity and Absorption of Coarse Aggregate
C 295-85	Petrographic Examination of Aggregates for Concrete
C 535-81	Resistance to Abrasion of Large Size Coarse Aggregate by Use of the Los Angeles Machine
D 1141-75 (R 1980)	Substitute Ocean Water

2. MATERIALS.

2.1 Definitions.

2.1.1 Cobblestone. Stone which is obtained from alluvial deposits and is nearly spherical and well rounded, ranging from 4 to 12 inches in size.

2.1.2 Quarry Stone. Stone which is obtained from a rock quarry and is angular in shape.

2.1.3 Stone. Sound, durable, weather-resistant rock from 4 to 12 inches in diameter resulting from quarrying of rock or from alluvial deposits.

2.2 Source and Material Approval. No stone shall be placed without prior written acceptance of stone from the source by the Contracting Officer. The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing and transporting of stone. The source(s) from which the Contractor proposes to obtain the material shall be selected and a sample submitted a minimum of 45 days in advance of the time when the material will be required in the work. Stone from a proposed source or sources will be tested by the Government for quality compliance.

The Government will test one sample at its expense. If the stone sample fails the tests, or if the Contractor wishes to use more than one source, additional testing will be accomplished by the Government for the sum of \$1,600 for each additional sample tested. The costs of such additional tests will be deducted from payment due the Contractor. All test samples (500 pounds minimum) shall be representative of the stone source and shall be obtained by the Contractor under the supervision of the Contracting Officer and delivered at the Contractor's expense to the South Pacific Division Laboratory, U.S. Army Engineer Division, South Pacific, Sausalito, California. The Contractor shall vary the quarrying, processing, loading and placing operations to secure the type and quality of stone protection specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the Government, other stone meeting the requirements of these specifications. Approval of a source shall not be construed as a waiver of the right of the Government to require the Contractor to furnish stone which complies with these specifications. Materials produced from localized areas, zones or strata will be rejected when such materials do not comply with the specifications.

2.2.1 Potential Stone Sources. The Contractor may elect to obtain cobblestone materials from the following potential sources in the Phoenix metropolitan area which have either undergone recent quality compliance testing for use on Corps of Engineer's projects or have acceptable service records:

Arizona Crushers, Inc. POC: Julie Haux (602) 242-5143

Blue Circle (Salt River) POC: Dan James (602) 253-2505

Sunstate Rock and Materials POC: Larry Walker (602) 848-8911

Union Rock and Materials Corp., POC: Chuck Peters (602) 276-4211

Stone may be furnished from the sources listed above, or at the option of the Contractor, may be furnished from other sources designated by the Contractor and approved by the Contracting Officer subject to the conditions stated herein. Listing of a stone source is not to be construed as approval of all materials from the source, nor as a waiver of inspection and testing of a designated source. Stone produced from a listed potential source must meet all the requirements set forth in this section. Listing of a stone source is also not to be construed as an indication that an individual potential source can produce the total quantity of stone required for the project.

2.2.2 If sufficient amounts of stone conforming to these specifications are not available from a source or sources used in the work, the Contractor shall submit stone from another source for approval.

2.3 Quality Compliance. Test results and/or service records may be used to determine the acceptability of the stone protection materials. In the event complete or current compliance test reports and/or service records are not available, the material shall be subjected to the tests outlined in these specifications to determine its acceptability for use in the work. In the event stone is accepted based on service records, samples of the actual stone to be used for construction shall be taken and shall be subjected to the tests outlined in these specifications. Before a proposed source or sources of cobblestone will be considered for sampling and testing the Contractor must demonstrate that the

gravel plant(s) has sufficient stockpiled cobblestone and results of sufficient explorations must be made available to the Government to demonstrate that an adequate quantity of cobblestone is available to fulfill the contract requirements. Before a proposed source or sources of quarry stone will be considered for sampling and testing, one of the following conditions must be met:

a. The quarry or quarries must be sufficiently developed to demonstrate that an adequate quantity of stone is available to fulfill the contract requirements; or

b. A sufficiently exposed face or faces must be present and results of sufficient explorations must be made available to the Government to demonstrate that an adequate quantity of quarry stone is available to fulfill the contract requirements.

2.3.1 Service records are considered to be acceptable if stone from a proposed source has remained sound with no significant deterioration after 10 or more years of exposure.

2.4 Quality Compliance Tests for Stone Protection. Stone shall meet the following test requirements.

Test	Test Method	Requirement
Specific Gravity (Bulk SSD)	ASTM C 127	2.50 minimum
Absorption	ASTM C 127	2.0% maximum
Wetting & Drying	SPD Test Procedure (1)	No fracturing (3)
Magnesium Sulfate	ASTM C 88 (2)	10% maximum loss (4)
Abrasion Loss	ASTM C 535	50% maximum loss

In addition to the above tests, the stone shall be subjected to a petrographic and X-ray diffraction analysis in accordance with ASTM C 295. The stone must not contain any swelling type clay (illite or montmorillonite).

NOTE: (1): Test procedure wetting-and-drying tests. The initial step of the test is the careful examination of the entire sample and the selection of representative test specimens. The piece should be large enough to produce two cut slabs, 1 inch thick  $\pm$  1/4 inch with a minimum surface area of 30 square inches on one side. Two chunks approximately three by four inches are also chosen. The slabs and chunks are carefully examined under a low-power microscope and all visible surface features are noted and recorded. The specimens are then oven dried at 140 degrees, F., for eight hours, cooled and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water prepared in accordance with ASTM D 1141. Each cycle consists of soaking for sixteen hours at room temperature and then drying in an oven for eight hours at 140 degrees F. After each cycle, the specimens are examined with the low-power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock.

The cycle in which any of these actions occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined and all changes in the rocks are noted and recorded. The test specimens together with all flakes or particles which come off during the test are oven dried, weighed and photographed.

NOTE: (2): The test shall be made on 50 particles each weighing 100 grams,  $\pm$  25 grams, in lieu of the gradation given in C 88.

NOTE: (3): Weakening and loss of individual surface particles is permissible unless bond of the surface grains softens and causes general disintegration of the surface material.

2.4.1 Stone to be used in the work shall be of the same lithology as the stone sampled for testing and for which service records are provided as a basis for approval. All stone shall be sound, durable, hard, and free from laminations, weak cleavages or undesirable weathering. Stone shall be of such character that it will not disintegrate from the action of air, water, or the conditions of handling and placing. All stone shall be clean and free from earth, clay, refuse, and adherent coatings.

2.5 Gradation Sampling and Testing for Stone Protection shall be performed by an approved testing laboratory on samples selected by the Contracting Officer. The Government reserves the right to perform check tests and to use the Contractor's sampling and testing facilities to make the tests. One gradation test shall be required at the beginning of production prior to delivery of stone from the source to the project site and a minimum of one additional test shall be required during stone placement. Each sample shall consist of not less than five tons of stone, selected at random from the production run for the first test or from material placed on grade or stockpiled on-site for required additional tests. All sampling and gradation tests performed by the Contractor shall be under the supervision of the Contracting Officer.

## 2.6 Gradation.

2.6.1 General. All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis diagram. The individual grading curves shall not exhibit abrupt changes in slope denoting skip grading or scalping of certain sizes. Specified grading of all material shall be met both at the source and as delivered to the project. In addition, material not meeting the required grading due to segregation or degradation during placement shall be rejected. If best results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed showing gradation requirements are met. All gradation tests shall be at the expense of the Contractor.

2.6.2 Stone may be obtained from any source approved by the Contracting Officer and shall be reasonably well graded between 4 and 12 inches with not less than 25 nor more than 50 percent passing 6 inches in size.

3. FOUNDATION PREPARATION AND STONE PLACEMENT.

3.1 Prior to placing stone, the subgrade shall have been compacted in accordance with the requirements of SECTION: EXCAVATION, FILLING AND BACK FILLING FOR STRUCTURES, and shall be inspected by the Contractor in sufficient time prior to each stone placement to certify to the Contracting Officer that it is ready to receive stone. The results of each inspection shall be reported in writing.

3.2 Stone shall be placed to produce a surface in which the tops of the individual stones have a tolerance of plus 2 inches to 0 inches from true grade. Double decking of the flat stones to bring the surface up to the required grade will not be permitted.

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SECTION 2M

GROUTING STONE PROTECTION

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| 2. Materials               | 5. Curing and Protection |
| 3. Mixing                  | 6. Test Panel            |

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.

C 33-86	Concrete Aggregates
C 150-85a	Portland Cement
C 309-81	Liquid Membrane - Forming Compounds for Curing Concrete

2. MATERIALS.

2.1 Aggregate shall conform to the grading requirements of ASTM C 33 specified for fine aggregate.

2.2 Portland Cement shall conform to the requirements of ASTM C 150, Type II. The alkali content of the cement shall not exceed 0.6 percent.

2.3 Water shall be fresh, clean, and potable.

2.4 Color Admixture. The color admixture shall conform to the requirements of the color admixture specified in the SECTION: CONCRETE.

2.5 Curing Compound shall conform to the requirements of ASTM C 309, Type 1-D. The compound shall be free of paraffin and petroleum.

3. MIXING. Grout shall be composed of cement, sand, and water mixed in proportions as directed. The Contractor shall add color admixture to all grout (except grout used in grouted stone toe below 2 feet vertically under the channel invert). Color of colored grout shall be considered satisfactory based on the comparative analysis of color produced from test panel(s) in accordance with the paragraph: TEST PANEL, and Munsell color samples in accordance with U.S. Department of Agriculture Handbook 18 - Soil Survey Manual. Color of the test panel shall conform to Munsell color number 10YR5/3 with respect to hue, value, and chroma. Evaluation of color shall be made within the time limits prescribed in paragraph: TEST PANEL. The estimated cement content required per cubic yard of the grout mix shall be 7-1/2 sacks. The water content of the mix shall not exceed 8-1/2 gallons per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate particles shall be included. Slump of grout mix shall be between 9 and 10 inches for the first course and between 7 and 8 inches for the second course or where one course

is placed. The grout shall be mixed in a concrete mixer in the manner specified for concrete, except that time of mixing shall be as long as is required to produce a satisfactory mixture, and the grout shall be used in the work within a period of 30 minutes after mixing. Retempering of grout will not be permitted. The consistency of the grout shall be such as to permit gravity flow into the interstices of the stones with the help of spading, rodding, and brooming. Grout batches in the same course shall be uniform in mix, size, and consistency. The color admixture shall be batched in a manner that will assure that the admixture is completely and thoroughly mixed throughout the batch.

#### 4. PLACING.

4.1 Prior to grouting, the stone shall be thoroughly washed with water to wash down the fines and to prevent absorption of water from the grout. The stone shall be kept wet just ahead of the actual placing of grout.

4.2 The grout shall be placed in one course in flat areas and in 2 courses in side slopes. Each course shall be placed full width or in successive lateral strips approximately 10 feet in width, as applicable, extending from toe of slope to top of side slopes. The grout shall be brought to the place of final deposit by approved means and discharged directly on the stone. A splash plate of metal or wood shall be used where necessary to prevent displacement of stone directly under discharge. The flow of grout shall be directed with brooms or other approved baffles to cover the entire area and to assure that all crevices are filled. Sufficient barring shall be done to loosen tight pockets of stone and otherwise aid the penetration of grout. The first course shall fully penetrate the stone blanket. The second course shall be placed as soon as the first course has sufficiently stiffened so that it will not flow when additional grout is added. On side slopes, all brooming shall be uphill.

4.3 Placement and brooming of the grouted surface shall be such that the outer layer of rock projects  $1/3$  to  $1/4$  their diameter above the grouted surface. After the top course has stiffened the entire surface shall be rebroomed to eliminate runs in the top course and to fill voids caused by sloughing of the layers of grout.

4.4 All surfaces of grouted stone, above the embedment depth specified, shall be cleaned by air-water blasting, sandblasting or a combination thereof.

##### 4.4.1 Air-water Blasting.

4.4.1.1 Equipment used for air-water blasting shall be capable of producing a minimum pressure of 150 psi and shall be of such nature as to adequately perform the work required.

4.4.1.2 The grout will be allowed to set for a minimum of one hour, or other length of time as directed by the Contracting Officer before air-water blasting is commenced. The air-water blasting shall be at right angles to the surface of the grout.

4.4.2 Sandblasting. All grouted stone surfaces to which grout has been applied and cannot be cleaned adequately by air-water blasting will be sandblasted, in order to remove grout paste remaining on the surface. Sandblasting will not commence at least 14 days after placement of the grout.

4.5 After completion of any strip or panel, to include cleaning, no workmen or other load shall be permitted on the grouted surface for a period of 24 hours. The grouted surface shall be protected from injurious action of the sun; shall be protected from rain, flowing water, and mechanical injury; and shall be moist cured or membrane cured at the Contractor's option.

#### 5. CURING AND PROTECTION.

5.1 Moist curing shall consist of covering the grout with a uniform thickness of 2 inches of sand which shall be kept continuously saturated for a period of 14 days.

5.2 Curing compounds shall be applied as soon as the free water disappears and shall be applied in a 2-coat continuous operation by approved power-spraying equipment at a rate not to exceed 200 square feet per gallon for the combined coats. The second coat shall be applied to overlap the first coat in a direction approximately at right angles to the direction of the first application. Curing compounds shall conform to the requirements of ASTM C 309, Type 1-D.

6. TEST PANEL. The Contractor shall place a test panel for colored grout with a dimension of 20 feet by 20 feet by 12 inches thick. The test panel shall be placed in the presence of the Contracting Officer, and the stone and grout mix design shall conform in all respects to those proposed for use in the project. The grouted stone shall be finished, protected, and cured on a 2H to 1V slope on the site of proposed construction using methods proposed for use by the Contractor on the features of the project which shall receive colored grout. The test panel shall not be protected from the effects of the sun while curing. Color comparisons as a basis for acceptance of color shall not be made in less than 17 days after placement of grout for the test panel. Wetting of the grouted stone shall not be permitted within a period of 3 days prior to making color comparisons. No grouting of stone shall be scheduled for placement within 30 days of construction of the test panel, and no grout shall be placed prior to demonstrating compliance with finishing and color requirements herein. In the event that the test panel color does not conform to the color requirements of these specifications, the Contractor shall be required to place additional test panels for grout similar to the panels required for concrete under the SECTION: CONCRETE until a final mix design has been approved which supplies colored grout conforming to the requirements specified above. Approval of test panel color and mix design shall not relieve the Contractor of the requirements of these specifications. The Contractor shall not remove the test panel until all grouting stone work has been completed. At completion of grouting stone work, the test panel shall be considered scrap material and disposed of in accordance with SECTION: GENERAL REQUIREMENTS.

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SECTION 2N

DESERT GRAVEL SURFACING

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| 2. Materials               | 5. Placing and Compacting  |
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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.

C 117-69	Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
C 136-71	Sieve or Screen Analysis of Fine and Coarse Aggregates
D 75-71	Sampling Aggregates
D 4318-84	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
E 11-70	Wire-Cloth Sieves for Testing Purposes

2. MATERIALS.

2.1 Desert gravel shall be free from lumps, balls of clay, organic and other objectionable matter, and shall have a maximum particle size of 1/2 inch. The percentage between 1/2 inch and 1/4 inch shall be no less than 60 percent of the total volume. The portion of material passing the No. 40 sieve shall have a plasticity index less than 9.

2.1.1 Coloration shall match color of Desert Gravel(s) previously used on the Arizona Canal Diversion Channel Project between 47th Drive and Cactus Road, as approved by the Contracting Officer. The gravel shall be consistent in color.

2.1.2 Desert Gravel shall be any granitoid igneous rock which has been weathered in place and which has as principal constituents granular fragments of quartz and feldspar. It may also contain fragments of granite rock not yet broken down into the component minerals. The mineral shall remain stable when saturated with water.

2.1.3 Material shall be obtained from commercial sources.

2.1.4 Contractor shall submit color samples (minimum of 3) and gradations results to the Contracting Officer's Representative for approval prior to installation.

2.2 Weed barrier fabric shall be a permeable polypropylene fabric with a minimum thickness of 2 mil. and shall be a product commercially manufactured as a weed barrier fabric.

3. SAMPLING AND TESTING shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. Tests shall be performed in sufficient number to insure that materials meet specified requirements. Copies of test results shall be furnished to Contracting Officer.

3.1 Samples for material gradation and plastic-limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

3.2 Tests.

3.2.1 Sieve Analyses shall be made in conformance with ASTM C 117 and C 136. Sieves shall conform to ASTM E 11.

3.2.2 Plasticity Index shall be determined in accordance with ASTM D 4318.

4. PREPARATION OF SUBGRADE. Prior to constructing the desert gravel surfacing the subgrade shall be cleaned of all foreign substances. Ruts or soft, yielding spots that may appear in subgrade, areas having inadequate compaction, and deviations of the surface from requirements set forth herein shall be corrected by loosening, removing, and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements.

4.1 Herbicide. Areas to be covered with desert gravel or sand shall be treated with Dacthol or approved equal pre-emergent herbicide manufactured specifically as a plant hericide. The pre-emergent herbicide shall be applied at the maximum manufacturer's recommended rate for pre-emergent herbicides. The subgrade shall be thoroughly compacted and the areas shall be weed free prior to application of pre-emergent herbicide. The pre-emergent herbicide shall be applied to the ground in a slurry mix through a 50 mesh screen avoiding contact with existing plant materials. The pre-emergent herbicide shall be applied in two (2) applications, prior to and immediately following installation of desert gravel or sand.

4.2 Herbicide shall not be used in planting beds on the north side of ACDC between:

STA 311+00 and STA 293+55 (56th Avenue and Thunderbird Paseo)  
STA 290+00 and STA 277+00 (59th Avenue and Thunderbird Road Plaza)  
STA 220+50 and STA 204+90 (67th Avenue Plaza Area)

4.3 Weed barrier fabric shall be used in planting beds on the north side of ACDC between:

STA 311+00 and STA 293+55 (56th Avenue and Thunderbird Paseo)  
STA 290+00 and STA 277+00 (59th Avenue and Thunderbird Road Plaza)  
STA 220+50 and STA 204+90 (67th Avenue Plaza Area)

5. PLACING AND COMPACTING. Material shall be leveled to a uniform thickness so that the layer, after compaction, will not exceed the indicated thickness. Water shall be added by sprinkling and mixing or reduced by aeration as necessary until the water content is at optimum or at the percentage directed. Mixing shall be continued until a uniform distribution of water is obtained. The layer shall be thoroughly compacted for the full depth to at least 95 percent maximum density.

Adjustments shall be made in placing, spreading, or finishing procedures as may be directed to obtain uniform layer thickness and true grades, to minimize segregation and degradation where pertinent, to reduce or increase water content, and to insure a satisfactory course. Materials found unsatisfactory shall be replaced with satisfactory material or reworked to produce a satisfactory material. The finished surface shall be raked smooth.

5.1 Thickness of the desert gravel layer shall be 2 inches minimum and be placed as shown on the project plans.

6. MAINTENANCE. The finished surfacing shall be maintained in a satisfactory condition until accepted.

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SECTION 20

PLAYING SURFACES FOR OUTDOOR SPORTS FACILITIES

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| 4. Grade and Surface-Smoothness Requirements | 9. Court Lines and Restriction Markings      |
| 5. Provision for Special Athletic Fixtures   | 10. Maintenance of Turf Surfaces             |

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.).

TT-P-25E & Am-2	Primer Coating, Exterior (Undercoat for Wood, Ready-Mixed, White and Tints)
TT-P-102E & Am-1	Paint, Oil, Alkyd Modified, Exterior, White and Tints

1.2 American Society for Testing and Materials (ASTM) Publications.

C 33-86	Concrete Aggregates
C 144-84	Aggregate for Masonry Mortar
C 150-85a	Portland Cement
C 595-85	Blended Hydraulic Cements
D 1557-78	Moisture Density Relatively of Soil and Soil Aggregate Mixture Using 10-LB (4.54 kg) Rammer and 18-In. (457 mm) Drop.

2. EXCAVATION, TRENCHING, AND BACKFILLING where required, shall conform to SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR STRUCTURES.

3. GRADING. Fills required to bring the subgrade of playing surfaces up to required elevation shall be placed in horizontal layers of not more than 8 inches in loose thickness. Except for turf area, each layer shall be compacted to at least 90 percent of ASTM D 1557 maximum density and the top layer of all fills and excavated areas under the playing surfaces shall be compacted to 95 percent ASTM D 1557 maximum density. Turf area compaction shall not exceed 85 percent.

#### 4. GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS.

4.1 Turf and Sand Playing Surfaces. The finished surfaces of all turf and sand playing surfaces shall conform to the line and grade requirements shown on the drawings. Grade control shall be established and maintained by means of string line stretched between grade pins.

4.2 Portland Cement Concrete Playing Surfaces. The finished surfaces shall conform to the line and grade requirements shown on the drawings.

4.2.1 Horizontal Control. Forms shall be used around each individual playing area to be surfaced to maintain horizontal control of concrete playing surfaces. Forms shall be of straight wood or steel, of sufficient strength to resist springing during construction, and of height equal to the full depth of the finished surfacing. Metal forms shall be of approved section with a flat top surface and a base width equal to the height of the form. Forms shall be set with the upper edge to line and grade and shall be held rigidly in place by stakes placed on the outside of forms and set flush with the top edge of the form. The top surface of the forms when set to line and grade shall not vary more than 1/8 inch from a true plane.

4.2.2 Tests for Surface Smoothness. The finished surface of all Portland Cement concrete playing surfaces shall be tested with an approved 10-foot straightedge to reveal surface irregularities exceeding the tolerances specified herein. The Contractor shall furnish and maintain at the site, in good condition, one or more straightedges for use in testing the finished surface. Straightedges shall be constructed of aluminum and shall have blades of box or box girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall be equipped with handles to facilitate movement on the finished surface. The entire playing surface between perimeter forms shall be tested in both a longitudinal and a transverse direction on parallel lines 5 feet apart or less. The straightedge shall be in contact with the surface and shall be moved ahead one half the length of the straightedge for each successive series of measurements.

4.2.3 Tolerances. Areas of Portland cement concrete playing surfaces that deviate by more than 1/8 inch from the testing edge of the 10-foot straightedge shall be plainly marked and corrected.

5. PROVISION FOR SPECIAL ATHLETIC FIXTURES. During the process of establishing the subgrade and prior to the placement of topsoil or surfacing of playing areas, suitable provisions shall be made for the installation of all fixed or removable appurtenances and special athletic fixtures and for any subsurface construction required in connection therewith, as indicated, whether or not such fixtures are to be furnished under this section of the specifications. Such subsurface construction shall be accurately installed in accordance with the drawings.

5.1 Net supports for volleyball and goal supports for basketball and soccer should be installed as per manufacturer's instructions and coordinated with the City of Glendale and the Contracting Officer.

6. NATURAL TURF PLAYING SURFACES shall consist of well-established, grassed areas having a thickly matted root growth of selected grasses. Natural turf playing surfaces shall be established and maintained in accordance with SECTION: SEEDING.

7. SAND PLAYING SURFACES shall be a minimum depth of 10 inches and shall be placed on the areas as shown on the drawings and shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, oil, and other deleterious substances.

7.1 Sand shall conform to the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	100
No. 8	95-100
No. 16	80-100
No. 30	50-85
No. 50	25-60
No. 100	10-30

8. PORTLAND CEMENT CONCRETE PLAYING SURFACES shall conform to SECTION: CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION, modified herein, and be constructed either on a prepared subgrade or over a drainage course as indicated in the case of horizontal playing surfaces.

8.1 Aggregate. The nominal maximum aggregate size shall be 1-1/2 inches and shall conform to ASTM C 33.

8.2 Portland Cement. The cement shall conform to ASTM C 150, Type II, low alkali, or ASTM C 595, Type IP.

8.3 Thickness. Horizontal Portland cement concrete playing surfaces shall consist of concrete slabs 6 inches thick unless otherwise indicated.

8.4 Surface Finish. To comply with SECTION: CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION. Finish for courts shall be monolithic finish, except that the second steel-troweling to a burnished finish shall be omitted. The surface finish for throwing circles shall be a nonslip finish.

8.5 Color Coating and Marking Paint. After curing of the concrete surface for 7 days, the entire playing surface shall be covered with a color coat, spread in accordance with the manufacturer's instructions. Application shall be made when the temperature is above 55 degrees F and rain is not imminent. The coating shall brush easily, have good spreading characteristics, and be suitable for application with wide hair-type brooms or rubber squeegees. The coating shall not stain or discolor balls nor be scuffed off under foot in normal playing 24 hours after application. Playing lines shall be marked with marking paint having the same characteristics and performance as the color coating except that the paint shall be suitable for application by spray equipment. Both the coating and the paint shall consist of resin water emulsion with pigments. Coating and paint shall be suitable for use over all types of concrete surfaces. Neither the coating nor paint shall cause lifting, grazing, peeling, or damage to the surface.

9. COURT LINES AND RESTRICTION MARKINGS shall be as specified for surfaces indicated and shall be applied with the type of paint or other marking material best adapted for a weather-resistant and durable marking on the particular type of playing surface. Court lines for multiple court areas shall be applied with different colors as approved by the Contracting Officer.

10. MAINTENANCE OF TURF SURFACES. After the completion of construction and prior to acceptance by the Contracting Officer, the Contractor shall maintain turf surfaces as specified in SECTION: SEEDING.

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## SECTION 2P

### SEEDING

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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 Specification (Fed. Spec.).

O-F-241d

Fertilizers, Mixed, Commercial

1.2 U.S. Department of Agriculture.

Federal Seed Act of August 9, 1939 (53 Stat. 1275)

2. SUBMITTALS.

2.1 Samples. Representative samples of Contractor furnished topsoil and 10 pounds of each type of soil amendments to be used shall be submitted.

2.2 Certificates of Compliance and Certified Laboratory Test Reports. Before delivery, certificates of compliance shall be submitted certifying that materials meet the requirements specified. Where such certification requires a laboratory test, the test shall be certified and reported as part of the certificate of compliance. Testing shall be performed by an approved, independent laboratory within 7 days of submittal of reports. Test reports of a previously tested material shall be accompanied by certificates from the manufacturer certifying that the previously tested material is identical in all respects to that proposed for this project. Certified copies of the reports for the following materials shall be submitted.

2.2.1 Off-Site Topsoil - for pH, salts, potash, and phosphorus.

2.2.2 Organic Soil Amendments - for classification of total nitrogen, moisture, ash and organic matter, sand content, and pH.

2.2.3 Seed - for purity and germination.

2.3 Manufacturer's Literature. Manufacturer's literature on the following materials shall be submitted.

- a. Hydro-mulch
- b. Mulch
- c. Erosion Control Material

2.4 Maintenance Instructions. Written instructions for year-round care of installed turf and seeded area shall be furnished.

### 3. DELIVERY, STORAGE, AND HANDLING.

#### 3.1 Delivery.

3.1.1 Plant material shall be inspected upon arrival at the job site.

3.1.2 During delivery, seed materials shall be protected from contamination by detrimental material and moisture.

3.1.3 Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis and name. In lieu of containers, soil conditioners, and amendments may be furnished in bulk, and a certificate from the manufacturer indicating the above information shall accompany each delivery.

3.1.4 All pesticide material, including soil fumigants, shall be delivered to the site in the original unopened containers. Containers that do not have a legible label that identifies the Environmental Protection Agency registration number and the manufacturer's registered uses will be rejected.

#### 3.2 Storage.

3.2.1 Seed and soil amendments shall be kept in dry storage away from contaminants, insects and rodents. Soil sterilant shall be isolated from any other landscape materials. Pesticide material shall be kept in dry storage and shall not contaminate adjacent material, and shall be handled and stored following manufacturer's directions.

3.2.2 Storage of materials shall be in areas designated or approved.

### 4. MATERIALS.

4.1 Seed. Seed shall be certified to be the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures and pure live seed. Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. On-site seed mixing will not be allowed unless approved. Seed mixtures shall be proportioned by weight as follows.

Native Seed Mix

<u>Botanical Name</u>	<u>Common Name</u>	<u>Pure Live Seed (P.L.S.) lbs/acre</u>
Aristida purpurea	Purple Three-Awn	3.0
Baileya multiradiata	Desert Marigold	2.0
Cenchrus ciliaris	Buffelgrass	1.5
Cynodon dactylon	Bermuda Grass (Hulled)	1.5
Eragrostis lehmanniana	Lehmans Lovegrass	0.25
Eragrostis lehmanniana 'antherstoni'	Cochise Lovegrass	0.1
Eschscholtzia californica	California Poppy	5.0
Festuca megalura	Foxtail Fescue	4.0
Gaillardia pulchella	Indian Blanket	5.0
Plantago insularis	Wooly Indian Wheat	5.0
Schismus barbatus	Mediterranean Grass	1.5
Sphaeralcea ambigua	Globemallow	2.0
Sporobolus cryptandrus	Sand Dropseed	0.25
	P.L.S. lbs/acre	<u>31.10</u>

Weed seed shall not exceed one percent by weight of the total mixture.

Turfgrass Seed Mix

<u>Botanical Name</u>	<u>Common Name</u>	<u>Pure Live Seed (P.L.S.) lbs/acre</u>
Cynodon dactylon	Common Bermuda (Hulled)	
	Total P.L.S. lbs/acre	130

Weed seed shall not exceed one percent by weight of the total mixture.

4.2 Topsoil, if required, shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from well-drained borrow areas and shall be free of any admixture of subsoil, foreign matter, objects larger than 1/2 inch in any dimension, toxic substances, and any material or substance that may be harmful to plant growth. The pH range shall be 6.0 to 7.6. Topsoil that does not meet this pH range shall be amended by the addition of pH adjusters, at a rate recommended based on soil tests.

4.3 Soil Conditioners and Amendments.

4.3.1 Well-rotted or well-composted fir wood fiber chips and fir bark chips shall have 7.5 pounds of nitrogen added uniformly to each cubic yard and shall be free of chips, stones, sticks, soil, harmful turpentine residues, and toxic substances.

4.3.2 Gypsum shall be 90 percent pure, free of any toxic materials, and at least 95 percent by weight shall pass a 4-mesh sieve.

4.3.3 Fertilizer. Fertilizer shall be commercial grade, free flowing, uniform in composition and shall conform to applicable State and Federal regulations. Fertilizer shall conform to Fed. Spec. O-F-241, Type I, Level B, and shall bear the manufacturer's guaranteed statement of analysis. Fertilizers shall contain a minimum percentage of 16 nitrogen, of which 50 percent shall be organic,

20 available phosphoric acid, and 0 potash. When slow release nitrogen forms are used in the fertilizer mixture, they shall be derived from sulfur coated urea, urea formaldehyde, plastic or polymer coated prills, or isobuylenediurea.

4.3.4 Soil Sulphur shall be agricultural sulphur containing 99.5 percent sulphur and 0.5 percent inert ingredients.

4.3.5 Ferrous Sulfate (Hydrated) shall be commercial grade.

4.4 Mulch.

4.4.1 Mulch shall be free from weed, mold, and other deleterious materials.

4.4.2 Wood cellulose fiber mulch for use with hydraulic application of seed and fertilizer shall consist of specially prepared wood cellulose fiber processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of the application of materials (sawdust or grass clippings are not acceptable fibers). On an air-dry weight basis, the wood cellulose fiber shall contain a maximum of 12 percent moisture, plus or minus 3 percent at the time of manufacture. The combination of wood cellulose and recycled newsprint fibers shall contain a maximum of 10 percent moisture plus or minus 3 percent at the time of manufacture. The pH range for either mix shall be between 4.5 and 6.5. The wood cellulose fiber shall be manufactured so that:

a. After addition and agitation in slurry tanks with fertilizers, seeds, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry.

b. When hydraulically sprayed on the ground, the material will form a blotterlike cover impregnated uniformly with seed.

c. The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil. Shrinkage after wetting shall not exceed 20 percent of the surface area.

4.4.3 Straw. Stalks from clean barley or wheat shall be furnished in air-dry condition and with a consistency for placing with commercial mulch blowing equipment.

4.4.3.1 Tackifier for use with straw mulch shall be an anionic emulsified asphalt material.

4.5 Water. Water shall not contain elements toxic to plant life.

4.6 Herbicides and Pesticides. Herbicides and pesticides use must comply with all applicable State and Federal laws. Pesticides must be registered with the U.S. Environmental Protection Agency.

4.7 Erosion Control Material shall be a totally organic substance supplied in dry, powdered form, at least 70 percent of which is 92 percent pure muciloid, derived from plantago ovata-insularis husk. Erosion control material shall be water-soluble, non-toxic, hydrophylic and shall not inhibit germination.

## 5. SITE PREPARATION.

### 5.1 Preparation of Seeded Areas.

5.1.1 Tillage. Except on slopes steeper than 2 horizontal to 1 vertical, the soil shall be tilled to a depth of at least 6 inches. On slopes between 2 horizontal to 1 vertical and 1 horizontal to 1 vertical tillage, depths shall be 2 inches. On slopes steeper than 1 horizontal to 1 vertical, no tillage will be permitted. Tillage shall be accomplished by plowing, disking, harrowing, by the use of rototillage machinery or other approved operations until the condition of the soil is acceptable. The work shall be performed only during periods when beneficial results are likely to be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. Undulations or irregularities in the surface shall be leveled before the next specified operations. Seeded area shall be compacted to 80-85 percent.

### 5.1.2 Application of Soil Conditioners and Amendments.

5.1.2.1 Native Seed Mix Area. 16-20-0 fertilizer shall be applied at the rate of 400 pounds per acre. Shredded bark shall be applied at the rate of 200 cubic yards per acre, and soil sulphur and ferrous sulfate (hydrated) shall be applied at the rates of 175 pounds and 300 pounds per acre, respectively.

5.1.2.2 Turfgrass Seedmix Area. 16-20-0 fertilizer shall be applied at the rate of 300 pounds per acre. Gypsum shall be applied at the rate of 2100 pounds per acre, and soil sulphur shall be applied at the rate of 430 pounds per acre. Well-rotted or well-composted fir wood fiber chips and fir bark chips shall be applied at the rate of 125 cubic yards per acre and ferrous sulfate (hydrated) shall be applied at the rate of 200 pounds per acre.

5.1.3 All fertilizers, pH adjusters, and soil conditioners shall be incorporated into the soil to a depth of at least 4 inches and may be incorporated as part of the tillage operation, using a rotary tiller or similar type of equipment to obtain a uniform and well-pulverized soil mix.

5.1.4 During tillage operations, all sticks, stones, roots, and other objectionable material shall be removed and the soil shall be restored to an even condition immediately before seeding. All stones larger than one (1) inch in diameter shall be removed from the top one (1) inch of soil (finished grade) of turf seeded area. All stones larger than three (3) inches in diameter shall be removed from the surface of soil (finished grade) of native seed mix area.

## 6. APPLICATION.

6.1 Planting Seasons and Conditions. Planting shall not be done when the ground is frozen, snow-covered, or in an unsatisfactory condition for planting. Planting shall be done within the following dates.

6.1.1 Native seed sown from March 15 to April 30 for spring planting and from October 15th to November 30 for fall planting.

6.1.2 Turfgrass seed sown from May 15th to August 15th for spring and summer planting.

## 6.2 Seeding.

6.2.1 When mechanically seeding, seed shall be broadcast uniformly by approved sowing equipment at the specified rate for each mix. One-half of the seed shall be sown in one direction and the remainder shall be sown at the right angles to the first sowing. The seed shall be covered with soil to a maximum depth of 1/8 inch by means of a spiked-tooth harrow, cultipacker, or by hand-raking. Hand-seeding will be allowed only with the approval of the Contracting Officer.

6.2.2 Drill seeding shall be accomplished using approved equipment such as cultipacker seeders and grass seed drills. The seed shall be drilled uniformly to a maximum depth of 1/8 inch at the specified rate for each seed mix.

6.2.3 When hydroseeding, seed and mulch shall be mixed in the required amount of water to provide a homogeneous slurry and then uniformly applied under pressure at the following rates per acre.

Seed - as specified for each mix  
Wood - wood cellulose fiber mulch - 500 lbs.

6.2.3.1 The seed shall not remain in the hydroseeder for longer than three (3) hours.

## 6.3 Mulching.

6.3.1 Hydroseeded Area. After the hydroseeding operation, fertilizer, erosion control material, and wood cellulose fiber mulch shall be mixed in the required amount of water to produce a homogeneous slurry and then hydromulched under pressure at the following rates per acre (dry weight).

Wood cellulose fiber - 1500 lbs.  
16-20-0 commercial fertilizer - 200 lbs.  
Erosion control material - 130 lbs.

6.3.2 Mechanical and Drill Seeded Area. After seeding, well-rotted or well-composted fir fiber chips and fir bark chips shall be applied uniformly over the entire seeded area to a thickness of 3/8 inch. The area shall be immediately firmed with a roller not exceeding 90 pounds for each foot of roller width (when hydroseeding, rolling will not be required). Mulch shall be applied by hand, or by equipment approved by the Contracting Officer.

## 6.4 Straw Mulching.

6.4.1 Straw shall be applied over the seed and mulch of the native seed mix area. The rate of straw application shall be 3000 pounds per acre. The straw shall be applied by commercial mulch blowing equipment approved by the Contracting Officer.

6.4.2 An anionic emulsified asphalt tacifier shall be applied with the straw mulch at a rate of 200 gallons of concentrate per acre. The concentrate shall be diluted as a 50/50 mixture in water.

6.5 Protection of Seeded Areas. Immediately after seeding, the areas shall be protected against traffic or other use by erecting barricades, as required, and approved signs shall be placed at appropriate intervals until final acceptance.

7. TURFGRASS AND NATIVE SEED MIX AREA ESTABLISHMENT.

7.1 Length of Establishment Period.

7.1.1 The turfgrass establishment period will be in effect for 4 months or until the turf has been mowed three times, whichever is longer.

7.1.2 The establishment period for the native seed mix area shall be 4 months in duration.

7.2 Proper Stands of Plant Material.

7.2.1 An acceptable stand of turf at completion of establishment period is defined as a minimum of 20 plants per square foot and with no gaps larger than 6 inches in diameter occurring in the turf seeded area.

7.2.2 An acceptable native seed area at completion of the establishment period is defined as having no areas greater than 6 square inches containing no plants of the specified seed mix.

7.3 The Contractor shall be responsible for the establishment and proper care of the entire turf and native seed mix area.

7.4 Maintenance During The Establishment Period.

7.4.1 Turf Seed Mix Area.

7.4.1.1 The turf seed mix area shall be mowed to a height of 2 inches whenever the average height reaches 4 inches for at least 60 to 90 days of the establishment period. The clippings shall be removed. Mowing shall be done with sharp equipment on dry grass and firm soil.

7.4.1.2 The turf shall be watered at such intervals and at such a rate that wilting, puddling and runoff do not occur.

7.4.1.3 Weed removal shall be on an on-going basis.

7.4.1.4 The turf shall be fertilized after the first month of growth, applying 2 pounds of available nitrogen per 1000 square feet and again within one week of the end of the turf establishment periods using the same mix.

7.4.2 Native Seed Mix Area.

7.4.2.1 The Contractor shall provide the following maintenance: watering, fertilizing, overseeding and any other operation necessary to promote the growth of plants.

7.4.2.2 During the plant establishment period, the Contractor shall maintain an adequate supply of moisture within the root zone at all times. Necessary water shall be delivered at monthly intervals in the form of natural rain augmented as required by periodic waterings. Water shall not be applied with a force sufficient to displace mulch and shall not be applied so quickly that it cannot be absorbed by the mulch and plants.

7.4.2.3 The entire turf seeded area shall be fertilized with not less than one application per month during the period of establishment, at a rate of 4 pounds per 1000 square feet. Formula for the application shall be 16N-20P-0K.

8. FINAL ACCEPTANCE.

8.1 General. Final inspection and acceptance will be at the end of the establishment period of turfgrass and native seed mix areas. Acceptance will be based upon satisfactory stand of plants as defined in paragraph: TURFGRASS AND NATIVE SEED MIX AREA ESTABLISHMENT.

8.2 Replacement. Areas that do not have a stand of plants must be re-seeded. Rejected areas shall be re-seeded within acceptable planting dates as directed by the Contracting Officer.

9. CONSTRUCTION QUALITY CONTROL. Attention is directed to SECTION: CONSTRUCTION QUALITY CONTROL which requires the Contractor to perform quality control inspection, testing, and reporting.

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SECTION 2Q

CACTI, TREES, SHRUBS, GROUND COVERS, VINES, AND NATIVE ROCK

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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.).

0-F-241d	Fertilizers, Mixed, Commercial
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1.2 American National Standards Institute (ANSI) Standard.

Z60.1-1986	American Standard for Nursery Stock
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1.3 American Joint Committee on Horticultural Nomenclature Publication.

Standardized Plant Names (2nd Ed., 1942)

1.4 American Society for Testing and Materials (ASTM) Publications.

C 136-84a	Sieve Analysis of Fine and Coarse Aggregates
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D 2607-69	Peats, Mosses, Humus, and Related Products
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1.5 American Wood-Preserver's Association (AWPA) Publication.

C2-85	Lumber, Timbers, Bridge Ties and Mine Ties--Preservative Treatment by Pressure Processes
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2. SOURCE INSPECTIONS.

2.1 Plant Materials. Plant materials shall be inspected at the growing site and tagged or otherwise approved for delivery. Such inspection does not preclude the right of rejection at the project site.

3. SUBMITTALS.

3.1 Maintenance Instructions. Written instructions for year-round care of installed plants shall be furnished in accordance with the SPECIAL CLAUSES.

3.2 Identification. All plants shall be identified with durable waterproof labels and weather-resistant ink. Labels shall be securely attached to plants, bundles, or containers of plants and shall state the correct botanical plant name and size.

#### 4. DELIVERY, STORAGE, AND HANDLING.

##### 4.1 Delivery.

4.1.1 Plant material shall be inspected upon arrival at the job site and unacceptable plant material shall be removed from the job site. The Contractor shall notify the Contracting Officer of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site.

4.1.2 Plants shall be protected during delivery to prevent damage to the root balls or desiccation of leaves. Trees shall be protected during transportation by tying in the branches and covering all exposed branches.

4.1.3 Soil conditioners and amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis and name. In lieu of containers, soil conditioners and amendments may be furnished in bulk and a certificate from the manufacturer indicating the above information shall accompany each delivery.

4.1.4 All pesticide material, including soil fumigants, shall be delivered to the site in the original unopened containers. Containers that do not have a legible label that identifies the Environmental Protection Agency registration number and the manufacturer's registered uses will be rejected.

##### 4.2 Storage.

4.2.1 Plant Storage. Plants not installed on the day of arrival at the site shall be stored and protected. Outside storage locations shall be continually shaded and protected from the wind. Plants, including those in containers, shall be kept in a moist condition until planted by watering with a fine mist spray. The Contractor shall take all necessary steps to insure that the plants are maintained in a healthy growing condition until planted.

4.2.2 Storage of Other Materials. Soil conditioners and amendments shall be kept in dry storage away from contaminants. Soil sterilant shall be isolated from any other landscape materials. Pesticide material shall be kept in dry storage and shall not contaminate adjacent material, and shall be handled and stored following manufacturer's directions. Storage of materials shall be in areas designated or as approved by the Contracting Officer.

4.3 Handling. Care shall be taken to avoid drying or damaging plants being moved from the nursery or storage area to the planting site. Balled and burlapped plants shall be handled carefully to avoid cracking or breaking the earth ball. Plants shall not be handled by the trunk or stems. Damaged plants will be rejected and shall be removed from the site.

## 5. MATERIALS.

### 5.1 Plants.

5.1.1 Plants shall be nursery grown or plantation grown stock conforming to ANSI Z60.1 and shall be of the varieties specified in the plant list bearing botanical names listed in the publication for Standardized Plant Names.

5.1.2 Planting stock shall be well-branched and well-formed, sound, vigorous, healthy, and free from disease, sun-scald, windburn, abrasion, and harmful insects or insect eggs and shall have healthy, normal, and unbroken root systems. Deciduous trees and shrubs shall be symmetrically developed, of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements. Evergreen trees and shrubs shall have well-developed symmetrical tops with typical spread of branches for each particular species or variety. Ground covers and vines shall be vigorous, have the number and length of runners and clump size specified, and be the proper age for the grade of plants specified. Only vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections shall be used. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Plants budding into leaf or having soft growth shall be sprayed with an antidesiccant at the nursery before digging.

5.1.3 The minimum acceptable sizes of all plants, measured before pruning and with branches in normal position, shall conform to the measurements indicated. Plants larger in size than specified may be used as approved. If larger plants are used, the ball of earth or spread of roots shall be increased in accordance with ANSI Z60.1.

5.1.4 Plants shall be dug and prepared for shipment in a manner that will not cause damage to branches, shape, and future development after planting.

5.1.5 Balled and burlapped and balled and potted plants shall have ball sizes and ratios conforming to ANSI Z60.1. Plants shall be balled with firm, natural balls of soil. B & B plants shall be wrapped firmly with burlap, strong cloth, or plastic and tied.

5.1.6 Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers but shall not be root bound.

### 5.2 Topsoil.

5.2.1 Additional topsoil, if required, shall be a natural, friable soil representative of productive soils at the site. It shall be obtained from well-drained areas and shall be free of any admixture of subsoil, foreign matter, objects larger than one inch in any dimension, toxic substances, and any material or substances that may be harmful to plant growth. The pH range shall be 6.0 to 7.6. Topsoil that does not meet this pH range shall be amended by the addition of pH adjusters.

### 5.3 pH Adjusters.

5.3.1 Soil Sulphur shall be a minimum 90 percent pure.

5.3.2 Iron Sulfate shall be commercial grade.

### 5.4 Soil Conditioners and Amendments.

5.4.1 Peat shall be a natural product of hypnum moss peat derived from a freshwater site conforming to ASTM D 2607 except as otherwise specified. Peat shall be shredded and granulated to pass a 1/2-inch mesh screen and conditioned in storage piles for at least 6 months after excavation.

5.4.2 Well-rotted or well-composted fir wood fiber chips and fir bark chips shall have 7.5 pounds of nitrogen added uniformly to each cubic yard and shall be free of chips, stones, sticks, soil, and toxic substances.

5.4.3 Gypsum shall be 90 percent pure, free of any toxic materials, and at least 95 percent by weight shall pass a 4-mesh sieve.

5.5 Fertilizer. Fertilizer shall be commercial grade and uniform in composition.

5.5.1 Granular fertilizer shall conform to Fed. Spec. O-F-241, Type I, Level B, and shall bear the manufacturer's guaranteed statement of analysis. Granular fertilizer shall be an osmotically released, non-burning type having a minimum analysis of 14-14-14 (N-P-K).

5.5.2 Packet, tablet, pellet, or other forms of slow release fertilizers may be used conforming to Fed. Spec. O-F-241, and shall bear the manufacturer's guaranteed statement of analysis. Slow release fertilizers shall contain a minimum percentage by weight of 20 nitrogen of which 10 percent shall be organic, 10 available phosphoric acid, and 5 potash.

5.6 Planting Soil Mixture shall be composed of 6.5 parts topsoil and 1 part peat, with 2.5 pounds commercial fertilizer, 4 pounds gypsum, 2 pounds sulphur, and 2 pounds iron sulphate added per cubic yard of mix.

5.7 Water holding granules shall be a stable synthetic anionic polymeric (polyacrylamide) crystal, having neutral pH (7.0).

5.8 Desert Interpretive Soil Mixture shall be composed of 2 parts site topsoil, 1 part gravel, and 1 part nitrolized shredded bark, with 2 pounds of iron sulphate added per cubic yard of mix.

5.9 Gravel Fill for Desert Interpretive Soil Mix shall consist of uniformly graded sand, stone, or gravel, free from an excess of soft or unsound particles or other objectionable matter. When tested in accordance with ASTM C 136, the material shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8-inch	100
No. 4	85-100
No. 16	45-80
No. 50	10-30
No. 100	0-10
No. 200	0-3

5.10 Mulch shall conform to the specifications, reference SECTION: DESERT GRAVEL SURFACING.

5.11 Staking Material.

5.11.1 Stakes for tree support shall be lodge pole pine, free from knots, rot, cross grain, or other defects that would impair the strength. They shall be standard stakes treated with pentachlorophenol or pressure-treated (wolmanized), and be of minimum 2-1/2 inches in diameter by 8 feet long and pointed at one end. Ground stakes shall be a minimum of 2 inches by 2 inches and 3 feet long and pointed at one end.

5.11.2 Tie wire shall be 12 gage annealed galvanized steel.

5.11.3 Rubber Hose chafing guards shall be new 2-ply reinforced rubber or plastic hose and shall be all the same color on the project. Length shall be one and one-half times the circumference of the plant at its base.

5.12 Water. Water shall not contain elements toxic to plant life.

5.13 Herbicides and Pesticides. Herbicides and pesticides used must comply with all applicable state and federal laws and be registered with the U.S. Environmental Protection Agency.

5.14 Native Rock shall be sound, durable and indigenous in geology to the region. Native rock shall be obtained from commercial sources and approved by the Contracting Officer. Native Rock shall have a well-weathered, rounded surface and be similar in geologic color to granite found in the region. The size shall be as noted on the plans.

5.15 Annual Color Plant Material. Plant material shall consist of annuals typically used in the landscape trade within the Phoenix, Arizona area as "Irrigated Flowering Accent Ornamental Annuals". A minimum of three (3) and a maximum of five (5) species shall be provided, each with a different color and mature height range, not to exceed 18-inches, as approved by the Contracting Officer. Plant material shall be triangularly spaced a maximum of 6-inches on center unless otherwise approved by the Contracting Officer. At full plant maturity (optimum flowering display period), plant material shall completely cover the annual color bed area, with taller plants used as background plantings and smaller plants used as foreground plantings. Plant material species shall be limited to those plants whose germination/recommended planting period corresponds to the project plant establishment period.

6. SITE PREPARATION.

6.1 Clearing and Grading. Clearing shall consist of the satisfactory removal and disposal of brush, snags, and rubbish occurring within the area shown or as directed by the Contracting Officer. Clearing shall be accomplished by hand within 5 feet of existing vegetation to be left standing. Grading shall conform to the lines and grades shown.

6.2 Layout. Plant material locations and bed outlines shall be staked on the project site before any plant pits or beds are dug. Plant material locations may be adjusted by the Contracting Officer to meet field conditions.

6.3 Protection of Existing Vegetation. If lawns have been established prior to planting operations, the surrounding turf shall be covered before excavations are made in a manner that will protect turf areas. Existing trees, shrubbery, and beds that are to be preserved shall be barricaded in a manner that will effectively protect them during planting operations.

6.4 Turf Removal. Where planting beds occur in existing turf areas, the turf shall be removed to a depth that will ensure the removal of the entire root system.

6.5 Underground Obstructions to Planting. If underground utilities, construction, or solid rock ledges are encountered, other locations for planting may be selected by the Contracting Officer.

6.6 Plant Pits. Plant pits shall be dug to produce vertical sides and flat, uncompacted bottoms. When pits are dug with an auger and the sides of the pits become glazed, the glazed surface shall be scarified. The size of plant pits shall be as shown.

6.7 Plant Beds in Existing Soil (Annual Color Area and Area with Plants from Flats). The following soil amendments shall be uniformly spread over the planting bed at the following rates per 1000 square feet:

- 3.5 cubic yards peat
- 62.5 pounds commercial fertilizer
- 100.0 pounds gypsum
- 50.0 pounds sulphur
- 2.0 pounds iron sulfate
- 10.0 pounds anionic polymeric crystal

The soil amendments shall then be thoroughly incorporated into the top 8 inches of existing soil using a rotary-tiller or similar type of equipment to obtain a uniform and well-pulverized soil mix. During tillage operations all sticks, stones, roots, and other objectionable materials shall be removed. Plant beds shall be brought to a smooth and even surface conforming to established grades.

6.8 Plant Beds in Concrete Slope Protection Area shall conform to planting soil mixture requirements of paragraph 5.6.

6.9 Herbicide and Pesticide Application. Herbicides, insecticides and fungicides shall be applied as needed and in accordance with the manufacturer's recommendations.

6.10 Plant bed areas shall be compacted to 80-85 percent.

## 7. INSTALLATION.

7.1 Planting Seasons and Conditions. Planting shall be done when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting. Planting shall be done within the following dates.

a. Deciduous material from March 1st to May 15th for spring planting and from October 15th to December 15th for fall planting.

b. Evergreen material from February 1st to May 15th for spring planting and from October 15th to December 15th for fall planting.

c. Desert Interpretive Plants from October 1st to February 1st.

7.2 Setting Plants. Container-grown plants shall be handled and moved only by the ball or container. Plants shall be set plumb and held in position until sufficient soil has been firmly placed around roots or ball. Plants shall be set in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery, collecting field, or container. Fertilizer in packet or tablet form shall be placed prior to backfilling and in accordance with the manufacturer's recommendations. Ground cover plants may be planted after the mulch is in place. Care shall be taken to avoid contaminating the mulch with the planting soil.

7.2.1 Sun orientation of cacti and other succulents shall remain the same as before they were collected.

7.2.2 Container-grown stock shall be removed from containers without damaging plant or root system. Planting shall be completed as specified for balled and burlapped plants.

7.3 Fertilization. After establishment of finished grade around plants, all bed areas shall be topdressed with fertilizer at the rate of 4 pounds per 1000 square feet of area. Fertilizer adhering to plants shall be flushed off.

7.4 Watering. All watering shall be done in a manner which will provide uniform coverage but which will not cause erosion or damage to the finished surface. Sufficient water shall be applied to penetrate the planting bed to a depth of 4 inches.

7.4.1 All plants shall be watered immediately after planting.

7.5 Edging materials shall be installed as indicated on the plans.

7.6 Erosion Control Netting shall be laid per manufacturer's recommendations and shall be utilized only if and where erosion presents a problem during the maintenance period. Type of erosion control netting shall be as approved by the Contracting Officer.

7.7 Native Rocks shall be placed, backfilled, and compacted to conform to detail indicated on plans. Care shall be taken not to mar or damage the Native Boulders during transportation and placement. Boulders with damaged surfaces will not be accepted.

7.8 Staking.

7.8.1 Plants shall be staked as indicated. The plants shall be held firmly between the stakes with guying lines to each stake. Hose chafing guards shall be used where wire would contact the plant.

7.8.2 Standard stakes shall be driven vertically into the ground to a depth of 12 inches minimum below bottom of plant pit and in such a manner as not to injure the ball or roots.

## 7.9 Mulching.

7.9.1 Mulching shall take place within 24 hours after planting.

7.9.2 Mulch shall be kept out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

7.9.3 Mulch planting beds and shrubs to a uniform thickness of 2 inches.

7.9.4 Trees located in planting beds shall be mulched to a uniform thickness of 4 inches.

## 7.10 Pruning.

7.10.1 New plant material shall be pruned in the following manner. Dead and broken branches shall be removed. Trees and shrubs shall be pruned to reduce total amount of anticipated foliage by one-fourth to one-third. Typical growth habit of individual plants shall be retained with as much height and spread as is practicable. Cuts shall be made with sharp instruments, and shall be flush with trunk or adjacent branch to ensure elimination of stubs. "Headback" cuts at right angles to line of growth shall not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off." Trimmings shall be removed from the site.

7.11 Waste Removal and Turf Repair. Excess and waste material shall be removed from the site. Existing grass areas that have been damaged or scarred during planting operations shall be restored to their original condition.

7.12 Maintenance During Installation. Maintenance operations shall begin immediately after each plant is planted and shall continue as required until final acceptance. Plants shall be kept in a healthy growing condition by watering, pruning, spraying, weeding, and any other necessary operations of maintenance. Plant saucers and beds shall be kept free of weeds, grass, and other undesired vegetation. Plants shall be inspected at least once per week during the installation period and needed maintenance performed.

7.13 Trees and shrubs located within native seed areas shall be planted no closer than 16 feet apart.

## 8. PLANT ESTABLISHMENT.

8.1 Beginning Date. Plant establishment shall begin on the date all plants are in place as specified and accepted by the Contracting Officer.

### 8.2 Establishment.

8.2.1 Trees shall receive 21 gallons of water at weekly intervals in the form of natural rain or periodic waterings.

8.2.2 Plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone at all times in the form of natural rain or periodic waterings.

8.2.3 Plants shall be pruned and mulch replaced as required.

8.2.4 Stakes, guys, and eroded plant saucers shall be replaced as required.

8.2.5 In plant beds and planting basins, grass and weeds shall not be allowed to reach a height of 3 inches before being completely removed, including the root growth. When plants are in groups other than cultivated beds, the Contractor shall not permit grass or other vegetation between them to become more than 5 inches in height.

8.2.6 Other work, such as spraying insecticides and fungicides to control pests, shall be done to ensure plant survival in a healthy growing condition.

8.2.7 Plants shall be fertilized once between the 30th and 45th day of plant establishment period. Fertilization shall be either by topdressing at 4 pounds per 1000 square feet of plant pit or bed area or by tablet or packet form fertilizer applied as per manufacturer's recommendations. Fertilizer shall contain 20 percent nitrogen, 10 percent phosphoric acid, and 5 percent soluble potash.

#### 9. FINAL ACCEPTANCE.

9.1 Preliminary Inspection. A preliminary inspection will be held 4 months from the date of the beginning of the plant establishment period to determine plant acceptability and the number of replacements. Plants not in healthy growing condition will be noted, and as soon as seasonal conditions permit, shall be removed from the site and replaced with plants of the same species and sizes as originally specified. Alternate or substituted varieties of plants shall be used only if approved by the Contracting Officer.

9.2 Final Inspection. A final inspection of all plants will be held after the replacement planting has been completed. No additional plant establishment period will be required for replacement plants.

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SECTION 2R

IRRIGATION SYSTEM

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- |                            |   |
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| 1. Applicable Publications | 8. Disinfection                               |
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| 3. Excavation              | 10. Cleanup                                   |
| 4. Backfilling             | 11. Variation in Arrangement<br>of Sprinklers |
| 5. Materials               | 12. Submittals and Guarantee                  |
| 6. Installation            |   |
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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 Specifications (Fed. Spec.).

- |                         |   |
|-------------------------|---|
| WW-P-421C               | Pipe, Cast Gray and Ductile Iron,<br>Pressure (For Water and Other Liquids)   |
| WW-U-531D               | Unions, Pipe, Steel or Malleable Iron,<br>Threaded Connection, 150 lbs and 250 lbs  |
| WW-V-51E<br>& Int. Am-2 | Valve, Angle, Check, and Globe, Bronze,<br>(125, 150, and 200 lbs, Threaded End,<br>Flanged Ends, Solder Ends, and Brazed<br>End, for Land Use) |
| WW-V-54D<br>& Int. Am-1 | Valve, Gate, Bronze (125, 150 and<br>200 lbs, Threaded Ends, Flanged Ends,<br>Solder End and Brazed Ends for Land Use)                          |
| WW-V-58B                | Valves, Gate, Cast Iron; Threaded and<br>Flanged (for Land Use)   |

1.2 American National Standards Institute, Inc. (ANSI) Standards.

- |              |   |
|--------------|---|
| A 21.11 1972 | Rubber-Gasket Joints for Cast-Iron and<br>Ductile-Iron Pressure Pipe and Fittings |
| B 16.3 1977  | Malleable-Iron Threaded Fittings,<br>150 and 300 lbs                              |
| B 16.26 1975 | Cast Copper Alloy Fittings for Flared<br>Copper Tubes                             |

1.3 American Society for Testing and Materials (ASTM) Standards.

- |          |   |
|----------|---|
| A 120-84 | Pipe, Steel, Black and Hot-Dipped<br>Zinc-Coated (Galvanized) Welded and<br>Seamless, for Ordinary Uses |
|----------|---|

B 62-86	Composition Bronze or Ounce Metal Castings
B 88-86	Seamless Copper Water Tube
B 548-82	Method and Specification for Ultrasonic Inspection of Aluminum Alloy Plate for Pressure Vessels
D 256-84	Impact Resistance of Plastics and Electrical Insulating Materials
D 638-86	Tensile Properties of Plastics
D 648-82	Deflection Temperature of Plastics Under Flexural Load
D 792-86	Specific Gravity (Relative Density) and Density of Plastics by Displacement
D 1785-86	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D 1861-73	Homogeneous Bituminized Fiber Drain and Sewer Pipe
D 1862-73	Laminated-Wall Bituminized Fiber Drain and Sewer Pipe
D 2240-86	Rubber Property--Durometer Hardness
D 2241-86A	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
D 2464-76	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe-Fittings, Schedule 80
D 2466-78	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
D 2564-84	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
D 2774-72	Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
F 656-80	Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1.4 American Water Works Association (AWWA) Standards.

C 500-71	Gate Valves 3 In. Through 48 In. for Water and Other Liquids
C 651-86	Disinfecting Water Mains
C 700-64	Cold-Water Meters-Displacement Type
C 800-66	Threads for Underground Service Line Fittings
C 900-81	PolyVinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water

1.5 Maricopa Association of Governments (M.A.G.) Specifications 530 and 790.

1.6 City of Glendale, Arizona, "Design Requirements Booklet", latest edition.

1.7 Manufacturers' Standardization Society of the Valve and Fittings Industry, Inc. (MSS) Standards.

SP-58	Pipe Hangers and Supports-Materials, Design and Manufacture (1975)
SP-69	Pipe Hangers and Supports-Selection and Application (1976)

2. GENERAL. Piping connection to source of water supply is covered in SECTION: WATER LINES.

2.1 Above Ground Piping shall be as follows.

2.1.1 Within and downstream of irrigation stations at Sweetwater Avenue, Hearn Road, 71st Avenue, and 75th Avenue, piping shall be galvanized steel, copper pipe, or as shown on the project plans.

2.1.2 Within and downstream of irrigation stations at 59th Avenue, Thunderbird Road, and 67th Avenue, piping shall be ductile iron, except where copper pipe is shown on the project plans.

2.1.3 PVC plastic riser piping, where shown on the project plans, shall be Schedule 80.

2.2 Below Ground Piping. Pipe shall be plastic except where ductile iron is specified on the project plans. Pipe for sleeving shall be corrugated metal, galvanized steel, plastic, bituminized fiber pipe. The minimum cover for laterals and branches shall be 12 inches. The minimum cover for pressure lines shall be 2.5 feet except under roadways, parking and paved areas, and channel invert (including low-flow invert), the minimum cover shall be 3 feet. The minimum cover for polyethylene drip line shall be 4 inches. Electrical wire conduits and lateral line may be placed above the mainline in same trench as shown on the project plans.

2.3 Below ground piping from irrigations stations to P.O.C. shall be plastic or galvanized steel.

2.4 Sprinkler heads and control valves shall not be located within 18 inches of buildings or structure foundations.

2.5 Electrical work from source to irrigation stations shall conform to the applicable requirements of SECTION: ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

### 3. EXCAVATION.

3.1 General. All excavation of every description and of whatever substances encountered shall be performed to the depths indicated or as otherwise specified. During excavation, material conforming to the requirement of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING, FOR UTILITIES SYSTEMS shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and wasted as indicated or as directed. Grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods. Sheet piling and shoring shall be done as may be necessary for the protection of the work and for the safety of personnel.

3.2 Trench Excavation. Trenches shall be of the necessary width for proper laying of pipe. The banks of pipe trenches shall be as nearly vertical as practicable. Care shall be taken not to over-excavate. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Stones shall be removed as necessary to avoid point bearing. Except as hereinafter specified for wet or otherwise unstable material, overdepth excavation shall be backfilled as and with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe is encountered in the bottom of the trench, and overdepth is not indicated on the drawings, such material shall be overexcavated to a depth to allow for construction of a stable pipe bedding. The trench shall be backfilled to the proper grade with approved materials.

4. BACKFILLING. The trenches shall not be backfilled until all required pressure tests are performed and until the irrigation systems as installed conform to the requirements specified. Material for backfill shall conform to the requirements of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING, FOR UTILITIES SYSTEMS. After the irrigation system has been installed and tested, backfill material shall be placed in the trench in a 12-inch lift and settled with water. The electrical work shall then be installed with 2 inches of backfill placed over it. This lift shall then be completed and the final lift compacted with mechanical tampers or vibrators.

5. MATERIALS. All mainline (pressure), mainline fittings, and mainline appurtenances (valves, etc.) shall be minimum 315 psi working pressure. Materials shall conform to the respective specifications and other requirements specified below.

## 5.1 Pipe.

5.1.1 Galvanized Steel Pipe shall conform to ASTM A 120, standard weight.

5.1.2 Copper Pipe: ASTM B-88 type K annealed.

5.1.3 Plastic pipe shall conform to ASTM D 1785, Type 1, schedule 80 for pipe with threaded joints, or to ASTM D 2241, Type 1, Grade 1, 315 psi for pressure lines up to 6 inches diameter, AWWA C-900 for pressure lines above 6 inches diameter, and 200 psi for non pressure lines with solvent welded joints. Plastic pipe and fittings shall bear the seal of approval (NSF mark) or the National Sanitation Foundation's standard for plastic pipe and fittings for potable water service. Plastic pipe stored on construction site shall be protected from sunlight and from dirt entering pipe.

5.1.4 Ductile Iron Pipe (D.I.P.) shall conform to Fed. Spec. WW-P-421C.

5.1.5 Polyethylene pipe shall be 100 percent polyethvlene as follows:

1/2" I.D. .574" to .600" wall thickness .050" to .062"  
Melting Point - .065 grams per 10 minutes  
Plastic Recovery - 30%  
Tensile Strength at Break - 1665 pounds per square inch  
Elongation - 65%  
Brittleness at 76oC-zero failures from 10 samples  
Stress crack in 100% Igepol Solution - zero failures from 10 samples

5.1.6 Polyethylene pipe (dripline) shall have a maximum length of 500 feet if the line returns to the PVC lateral, or a maximum length of 300 feet if the line dead ends. Maximum flow (gpm) shall not exceed the manufacturer's recommendations for pipe size indicated.

## 5.2 Joints.

5.2.1 Plastic Pipe Joints shall be solvent welded or threaded. Plastic pipe joints shall be primed prior to solvent welding. Solvent for welded joints shall conform to ASTM D 2564. Use of pipe dope or solvents on threaded joints will not be permitted. Polyethylene shall have compression joints. Primer shall conform to ASTM F 656.

5.2.2 Copper tubing. Joints shall be compression-pattern flared and shall be made with fittings herein specified.

5.2.3 Flanges shall conform to AWWA C 207, and shall be used only in above-ground installations or where shown on the plans or where approved.

5.2.4 Insulating Joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Insulating joints shall consist of a sandwich-type flange insulating gasket of the dielectric type, insulating washers, and insulating sleeves for flange bolts. Insulating gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt insulating sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

5.2.5 Insulation Joints. A rubber-gasketed or other suitable type of insulating joint shall be provided to effectively prevent metal-to-metal contact between adjacent dissimilar metallic pipes or fittings.

### 5.3 Fittings and Specials.

5.3.1 For Ductile Iron Pipe. Fittings shall be ductile iron. Threaded fittings shall conform to ANSI B 16.3.

5.3.2 For Plastic Pipe. Fittings shall conform to ASTM D 2464 or D 2466.

5.3.2.1 For all change of direction fittings and couplings for 6 inch and larger PVC pipe and for reduction fittings to smaller PVC mainline pipe use Epoxy-coated steel fittings and couplings designed for working pressures to 200 psi which are (NSF) approved. All connections for PVC pipe 4 inches and smaller shall be primed prior to solvent welding.

5.3.2.2 Where a 3 inch or larger tap is required on 6 inch or larger PVC pipe, use a double strap saddle with cast bronze tapped insert.

5.3.2.3 Where taps smaller than 3 inch are required on 6 inch or larger PVC pipe, use a full body saddle with cast bronze tapped insert.

5.3.3 For Copper Pipe. Fittings and specials shall be flared and conform to ANSI B 16.26.

5.3.4 For Galvanized Steel Pipe. Steel fittings shall be galvanized. Threaded fittings shall conform to ANSI B 16.3.

5.4 Gate valves and stop valves shall be designed for a working pressure of not less than 200 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

5.4.1 Valves smaller than 3 inches shall be all bronze and shall conform to Fed. Spec. WW-V-54, Class C, Type 1. Handwheels shall be constructed of red bronze 85-5-5-5 percent ASTM B 62.

5.4.2 Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to Fed. Spec. WW-V-58, Class 2, Type 1. Valve connections shall be flanged.

5.5 Air Relief Valves shall have all cast iron body and dome construction with silicone seats, stainless steel lever and springs and be ASME tested and rated at 200 psi working pressure. Valves shall be one inch size.

5.6 Valve Boxes shall be plastic or concrete (unless otherwise indicated), in locations not subjected to vehicular traffic. Concrete or cast iron boxes with cast iron covers shall be used in areas subject to vehicular traffic. All valve access boxes shall have locking lids. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. Minimum dimensions shall be 30 inches long, 20 inches wide, and 12 inches deep. The words "Irrigate", for

gate valves; "PRV", for pressure relief valves; and "RCV" for remote control valves shall be cast in covers of boxes for the irrigation system. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at valve location. Plastic boxes shall be a standard catalog product of a manufacturer regularly engaged in the manufacture of valve boxes. Box housing shall have locking or boltable covers. Plastic shall be rigid combination of polyolefin and fibrous inorganic materials having the following physical properties:

ASTM Test	Method	Valve
Tensile Strength (2.0 in. Min.)	D-638	3,400 psi
Impact Strength, Izod	D-256	0.5 ft-lb/in
Shore-D Hardness	D-2240	63
Deflection Temp. @ 66 psi stress	D-648	230 degrees F
Specific Gravity	D-792	1.15

### 5.7 Backflow Prevention Units.

5.7.1 General. Backflow prevention unit(s) of the type indicated shall be installed above ground at the location(s) shown on the drawings. Pipe and fittings for backflow prevention units shall be as shown on project plans.

5.7.2 Backflow prevention unit shall be a factory assembled unit consisting of two independently acting spring-loaded check valves with a differential pressure relief valve controlled-reduced-pressure zone in between and shall be complete with test cocks and drain. The first check valve shall reduce the supply pressure a predetermined amount so that during normal flow and the cessation of normal flow the pressure between the checks is less than the supply pressure. The pressure differential relief valve shall automatically discharge to atmosphere to maintain the pressure in the reduced pressure zone below the supply pressure. All parts shall be removeable or replaceable without removal of the unit from the line. The unit shall be suitable for a working pressure of 200 pounds per square inch and shall be the product of a manufacturer regularly engaged in the production of backflow prevention units of the reduced pressure type. Reduced pressure principle assemblies shall conform to the project plans.

5.7.3 Where union connections are not provided as part of the unit, the Contractor shall provide and install a union between the control valve and inlet side of the unit.

### 5.8 Sprinklers.

5.8.1 General. Sprinkler heads of the types indicated shall be installed on swing risers as indicated. Size of riser pipe, minimum spacing of heads, radius of coverage, nozzle diameter, rate of water application and the available pressure at the riser, shall be as indicated for each type and size of head. Sprinkler units of each type shall be the product of manufacturers regularly engaged in the production of lawn sprinkler or irrigation equipment.

5.8.2 Rotor pop-up sprinklers shall be of the gear driven rotary type, capable of covering a radius at the psi, and with the discharge rates shown on the drawings. The sprinkler shall have a vandal resistant slip-clutch nozzle turret. The sprinkler shall be equipped with a drain check valve to prevent low

head drainage and with an inlet filter screen. The sprinkler shall have a pop-up height as shown on the drawings. The body of the sprinkler shall be constructed of non-corrosive heavy duty A.B.S. plastic. The cover shall be rubber and shall be standard on all sprinklers. The sprinkler shall have an exposed surface diameter of 1-5/8 inch and an overall height of 7-3/8 inch. The sprinkler shall be serviceable after installation in the field by unscrewing the body cap and removing the riser assembly, check valve and inlet screen.

5.8.2.1 The sprinklers shall be available in full or part circle configuration. The part circle unit shall be available in fixed arcs from 30 degrees to 270 degrees in 15 degree increments.

5.8.3 Rotor Turf Pop-up sprinklers shall be of the ball rotary type, capable of covering a radius at the psi, and with the discharge rates shown on the drawings. The sprinkler shall have an overall height of 4-1/4 inches. The sprinkler shall be equipped with self-flushing wiper seal and with a sand screen. The sprinkler shall have a pop-up height as shown on the drawings. The sprinkler shall be equipped with a heavy-duty ABS container, rubber cover, ground support flange and automatic reset reversal device.

5.8.4 Turf Spray Pop-Up Sprinklers. Sprinkler body shall be constructed of high impact ABS plastic, and shall have a stainless steel retraction spring. Each sprinkler shall have a built-in check valve. The cover shall be secured with stainless steel screws. Pop-up height as shown on drawings. Bottom inlet - 1/2 inch FPT. Each nozzle shall have a serviceable screen. Sprinkler nozzles shall be constructed of plastic, equipped with a throttle screw for radius adjustment, and shall provide for balanced precipitation rates. Maximum working pressure shall be 40 psi.

5.8.5 Shrubbery Spray Heads. Sprinkler body shall be constructed of high impact ABS plastic, and shall have a heavy duty stainless steel retraction spring. Each sprinkler shall have a built-in check valve. The cover shall be secured with stainless steel screws. Pop-up height as shown on drawings. Bottom inlet - 1/2 inch FPT. Each nozzle shall have a serviceable screen. Sprinkler nozzles shall be of the stream spray type 10° trajectory, equipped with a throttle screw for radius adjustment, and shall provide for balanced precipitation rates. Maximum working pressure: 30 psi.

5.8.6 Pressure Compensating Bubblers shall be constructed of durable ABS plastic. The pressure compensating device shall be made of Buna-N rubber. Bottom-inlet-1/2 inch FPT. The bubbler shall be non-adjustable and shall provide a constant flow rate between 15 and 90 psi.

5.8.7 Emitters. Emitters shall be independent compensating plastic in-line emitters (dripline), capable of providing consistent discharge rates of .48 (.50), one (1), and two (2) gallons per hour (gph), as required. The emitter shall be constructed of heat resistant plastic and have an operating range of 3 to 60 pounds per square inch (psi). Emitters shall be spaced 12 inches on center for groundcover and shrubs, and maximum of 24 inches for trees, spaced equally.

## 5.9 Drip System Accessories.

5.9.1 Filters shall be brass "y" type 100 mesh or finer, threaded at both ends with a "ball" type flush valve, of the sizes indicated on the drawings.

5.9.2 Regulators shall be brass with an opening pressure between 10 to 80 psi and with an outlet pressure between 15 to 30 psi, as indicated on the drawings.

5.9.3 Self flushing end caps with concrete or plastic boxes with locking lids, shall be provided at dead ends of all lateral lines and drip tubing runs.

5.9.4 Holder stakes for pipe (tubing) are to be galvanized steel at least 14-1/2 inches in length (7 inches when bent double as a staple).

5.9.5 All drip system accessories including pipe (tubing) and emitters, shall be the product of a manufacturer regularly and continually engaged in manufacturing of drip irrigation products for at least the past 5 years, as approved by the Contracting Officer. Polyethylene tubing and emitters shall be manufactured for underground installation.

#### 5.10 Remote Control Valves.

5.10.1 Remote Control Valves shall have pressure regulating capabilities, bodies and covers constructed of Dupont Zytel - 33 percent glass reinforced. The diaphragm shall be constructed of nylon reinforced Buna-N rubber. The internal trim shall be stainless steel, delrin and brass. The valve shall be electric two-way solenoid operated, diaphragm activated, with a manual flow control adjustment and internal manual bleed adapter. The solenoid shall be fully encapsulated, 24 volt, .3 amp inrush, .2 amp holding. The valve shall retain its pressure reducing capability when being manually operated. The valve shall be equipped with a fully adjustable pressure reducing pilot and furnished with a factory installed pressure gage. The valve shall maintain a constant outlet pressure regardless of fluctuations in pressure and flow on the inlet side of the valve. Pilot sensing shall be by means of a poly tube installed a minimum 24 inches downstream from the valve. The valve shall have female pipe thread end, installable in straight or angle pattern. Maximum working pressure: 200 psi. Remote control valves shall have a built-in pressure gage.

5.10.2 A 1/2-inch air vent valve/vacuum breaker shall be installed at the high point, with each remote control valve serving drip irrigation systems and shall allow air to purge up to 125 psi during the fill process and allow air to enter during drain-down. The valve shall be installed according to manufacturers requirements and as shown on the drawings.

Valve materials - Thermoplastic body, glass filled Polysuflone

Temperature - Max. operating temperature:  
200 degrees F under pressure  
250 degrees F unpressurized

Pressures - Max. operating pressure 100 psi proof pressure 150 psi,  
minimum

5.11 Automatic Controllers shall be Motorola MIR 5000F twenty-six (26) station capacity. The controller shall be connected by communication cable to the transmitter/receiver unit as shown on the drawings. The irrigation controller shall be mounted in a metal enclosure.

5.11.1 Automatic Irrigation Controller Components shall be compatible with the irrigation controller and shall be installed according to manufacturer's requirements and as shown on the drawings.

5.11.2 Digital Flow Monitor shall be a microprocessor based flow monitor with LCD which will display the flow rate and total flow rate at the push of a button. The flow monitor shall be capable of being calibrated in the field with the use of a front mounted keyboard.

5.11.3 Conduit Box Kit shall be a weatherproof enclosure for stand-alone mounting and shall meet NEMA 4x. An opening shall be provided for a standard 1/2 inch conduit fitting. Mounting brackets shall be welded to the aluminum enclosure allowing surface mounting to the irrigation enclosure.

5.11.4 Keyboard Security Kit shall prevent unauthorized or accidental resetting of total accumulated flow, pipe diameter calibration and pulse output calibration. Special security fasteners and spanner shall be provided.

5.11.5 Relay Output Kit shall provide SPDT relay. The relay shall be available in 12VDC or 24VDC coil voltages. The voltage requirement shall be as shown on the project drawings.

5.11.6 AC Power Adapter (transformer) shall be UL approved 120 VAC outlet plug-in power supply to provide 12VDC to the flow monitor.

5.11.7 Field Satellite Transceiver shall be a trunked radio and be of the same manufacturer as the irrigation controller used in the project. The radio shall be provided with the following features; a microprocessor control, audible status tones, and system privacy for efficient communication to a channel sharing the same trunked radio system. The radio shall be equipped with a durable 5dB gain performance antenna and be of the same manufacturer as the radio. The trunked radio and the antenna shall be installed according to the manufacturer's recommendation and as shown on the drawings.

5.11.8 Controller enclosure box shall be a NEMA 4, 12 gage steel, all welded enclosure 36 inch (W) x 18 inch (D) x 48 inch (H), having a full-gasketed hinged door, 3-point dead bolt latch mechanism, padlockable handle, and integral mounting racks compatible with specified controller, power supply and ancillary equipment. The preferred box is manufactured by Cross Brothers, Inc. and is known as a La Max Enclosure, specifically the "Arizona Box" which has additional louvers. A single access key shall be capable of opening all cabinets (provide two keys).

5.11.9 Charts. A chart, encased in plastic, showing clearly the areas serviced by each remote control valve shall be provided at each controller.

5.11.10 Controller Communications Cable (For Connecting Controllers A, D, F, G, Z, and Y, to Radio Antennas). The communication cable shall be provided by and installed by the Contractor. Communication cable may be installed in common trench with irrigation system piping and 24 volt wire where practical. The communication cable shall be tested and documented for continuity and resistance before and after burial. Splices of communication cable shall be done only in a valve box and a valve box shall be furnished for all splice points. Any necessary wire splices shall be waterproof epoxy type. Approximately 3 percent

cable slack shall be provided to prevent tensile stress. Contractor shall be responsible for communication cable connections to field controllers per manufacturer's specifications.

#### 5.12 Central Computer.

5.12.1 The Contractor shall furnish and install at the Field Operations Center City of Glendale, 6210 West Myrtle, Glendale, Arizona one Motorola computerized irrigation control center and one Motorola base radio station. Both units shall be manufactured, installed, and satisfactorily tested by an authorized representative of Motorola Communications International, Inc. In addition, Motorola Communications International shall provide all field technical support and labor necessary to assure that the computerized irrigation control center and base radio station properly interfaces with the remote irrigation station and its appurtenant components.

5.12.2 The central computer shall be a stand alone, fully enclosed unit including CRT, keyboard, processing memory and minimum 48 hour operational emergency battery back-up. All items in this bid are to be Motorola "MIR 5000" computer based, radio controlled water management system, or approved equal. All equipment must be compatible with the City of Glendale Radio Network.

5.12.3 The computer shall be IBM PS-2 Model 50 and include a minimum of 128K RAM, 1MB RAM, 20 MB fixed hard disk drive capable of operating IBM PC DOS 3.30. The computer shall include a minimum of four multiplex serial ports for expansion. The computer shall be a complete package, including IBM 8512 color monitor, IBM proprinter II, cables, DOS 3.30 software and 10 hi-density 3.30 inch diskettes.

5.12.4 The central computer package shall include a Field Interface Unit (F.I.U.), the host computer to operate and control, via R. F. trunked radio, a system of remote units for irrigation or water distribution control. The F.I.U. shall interface to the computer. The trunked radio shall be capable of operating on 5 to 20 channel trunked systems and be of the same manufacturer as the F.I.U. The trunked radio shall include antenna, transmission line and installation by F.C.C. certified personnel. F.C.C. licensing as required shall be coordinated by the Contractor on behalf of the City of Glendale.

5.12.5 The Field Operations Center City of Glendale will provide electrical outlets at computer and radio location and an operating telephone extension for remote maintenance capabilities through modem connection to CPU. The computer package will include an internal modem interface for connection to the phone system. The Contractor shall submit two copies of the operation and maintenance manuals for this equipment. All equipment to be furnished under this request for proposal shall be guaranteed by the Contractor for a period of one year from the date of acceptance thereof; either for beneficial use or final acceptance whichever is earliest, against defective materials, design, and workmanship.

5.12.6 The central computer shall operate on 115 VAC and have power isolation and communication line protection as recommended by manufacturer. The central shall be able to operate in normal environments common to parks and recreation operation and not require a specially controlled operating area.

5.12.7 The operational requirements of the central computer shall include but not be limited to:

5.12.7.1 Providing daily summary reports of irrigation activity and problem summary reports listing any irrigation schedules not completed and indicating the reason for incomplete schedules.

5.12.7.2 Have the ability (with the use of flow meters) to monitor actual flow vs. programmed flow.

5.12.7.3 Hydraulic network protection to monitor for broken lines or stuck valves that would affect proper irrigation.

5.12.7.4 Automatically compensate for hydraulic limits to prevent over programming.

5.12.7.5 Total random access of irrigation stations and sensor back indications allowing system matrixing of stations and sensors.

5.12.7.6 Irrigation status summary for instant reporting of all areas under computer control.

5.12.7.7 Accumulation reports to provide historic data on water use irrigation time per station in a weekly, monthly, and annual format.

5.12.7.8 Irrigation programming shall be user definable for ease of defining irrigation stations by plant type (i.e., turf, shrub, trees, native plants, etc.)

5.13 Tensiometers (moisture probes) shall be compatible with soils found at each location and solid state maintenance free units, which will react to changes in soil matrix potential and will not be affected by salts, fertilizer, chemical changes in the soils nor damage by freezing. The sensing range shall be factory preset and will require no adjustment or calibration. The tensiometer shall be adaptable for direct input to computer processors. The tensiometer shall be available in a minimum of three ranges to allow irrigation above a preset matrix potential. The operational voltage shall be 24 to 30 volts, 60 Hz., AC. Tensiometer size shall be as specified in the paragraph: INSTALLATION. The Contractor shall install the tensiometers according to the manufacturer's requirements and as shown on the project plans.

5.14 Tipping Bucket Rain Gage shall be a high quality accurate instrument used for measuring precipitation. Rainfall shall enter a 12 inch funnel collector and be directed to the tipping bucket assembly. The bucket shall be made of stainless steel. The funnel shall be anodized aluminum and have two screens to prevent debris from entering the gage. A level shall be provided on the base for correct positioning of the unit. The rain gage shall come with .04 inch calibration. The Contractor shall install the unit according to the manufacturer's requirements and as shown on the drawings. Contact Rating: 3 watts, 28 VAC, 0.25 amps, 120 VAC. Install rain gages at 59th Avenue, Thunderbird Road, 67th Avenue, and 75th Avenue only.

5.15 Fertilizer Injector shall be a feeder, water operated, positive displacement proportioning chemical metering pump equipped with a belt and coupling guard to comply with OSHA standards. The pump shall come with polyethylene plastic tubing, foot valve strainer, suction valve and discharge valve (sizes as recommended by manufacturer). The pump minimum operating pressure shall be 15 psi and the maximum operating pressure shall be 125 psi. The fertilizer injector shall have a

chemical to water ratio of 1:730 maximum. The fertilizer injector shall have the following options: diaphragm-hypalon, Head-PVC, Valve-double, single head fittings-universal injectors. The Contractor shall install the fertilizer injector according to the manufacturer's requirements and as shown on the drawings.

5.16 Solution Tank. The fertilizer storage tank shall be a 50 gallon, 316 stainless steel container, equipped with a locking stainless steel vented lid. The tank shall be equipped with a 1/10 h.p. agitator mixer. The suction line shall be equipped with a foot valve strainer.

5.17 Flow Sensor (meter) shall be a six-bladed design with a proprietary, non-magnetic sensing mechanism. The sensor shall be supplied with a two conductor, shielded cable extending out through a conduit connection on top of the sensor. The sensor shall be mounted in a threaded brass pipe tee. The flow sensor shall have a maximum pressure range of 200 psi for 2-1/2 inch size, 100 psi for larger size, and a flow range of 30-1 feet/second. The Contractor shall install the flow sensor according to the manufacturer's requirements and as shown on the project drawings.

5.18 Motorized Ball Valve. The electric actuator and the ball valve shall be of the same manufacturer. The motorized ball valve shall have manufacturer supplied micro switches for position indication. Position indications shall be wired to back indication of irrigation controller. The ball valve shall have the following options:

- Body, Pipe Ends - Brass or Carbon Steel
- Ball Stem - 316 S.S.
- Seat - TFE
- Body Seal - TFE
- Ends - Screwed Pipe Ends

The Contractor shall install the motorized ball valve according to the manufacturer's requirements and as shown on the project drawings.

5.18.1 Electric actuator shall be compatible with the irrigation controller. The actuator shall have multi-function capabilities. The housing shall be NEMA IV watertight. Gearing shall be two stage planetary gear, permanently lubricated self locking train. The electric actuator shall have the following options:

- Torque in./lbs. - 600
- Voltage VAC - 115
- Duty Cycles - 100%
- 90 degree/time seconds - 23
- Locked Rotor Current + (Amps) 113 VAC - .46
- Option - 2 additional micro switches
- Travel Stops - Stops for 90 degree operation

5.18.2 Ball Valve shall be of three piece construction for easy installation and inline maintenance. The ball valve shall be a two-way ball valve designed to seal on the downstream side against a resilient seat.

5.19 Pressure Sensor (switch) shall be operated by a brass Bourdon tube actuating a mercury switch and inclosed in a weather-resistant housing. Switch shall have deadband adjustable operating range from 5-150 psig. Switch shall have calibrated dial and two pointers indicating set and reset points. Switch shall have visible on/off indication. Set points shall be adjustable without removing switch cover or shutting down process. The pressure sensor shall be enclosed in a NEMA type enclosure, and shall be lockable, size as required. The Contractor shall install the pressure sensor according to the manufacturer's requirements and as shown on the project drawings.

5.20 Electrical wiring from controller to control valves shall be solid, single conductor, copper wire, size recommended by the controller manufacturer except that minimum wire size shall be No. 14 or unless otherwise noted. Common wire shall be minimum wire size of No. 12. Regardless of the number of locations of valves connected to a single controller station separate control wires shall be run from the controller station to each valve. Wiring from controllers to panel shall be installed in rigid conduit.

5.21 Quick Coupling Valves shall be two piece, spring-loaded, compression type, normally closed, opening against line pressure, and actuated by downward thrust against the valve. Body shall be of heavy duty brass construction. Machined parts shall be fabricated from red brass. Valve washers and sealers for key stems shall be of a semi-rigid, non-metallic material and shall be easily replaceable. Inlets shall be tapped for one inch National Standard pipe thread. Valves shall be suitable for a maximum operating pressure of 125 psi and shall be the standard product of a reputable manufacturer of quick coupling valves for lawn sprinkling systems. The Contractor shall furnish coupler keys for operating the valves with hose swivels. Rubber sleeves shall be the standard product of the manufacturer of quick coupling valves and when required they shall replace hinged cover as regularly furnished. Each sleeve shall have a cover.

5.22 Hose Bibbs (Hose Valves) shall be of the angle valve type and shall be of all brass composition. Valves shall be 3/4-inch size installed at least 12 inches above grade. Connecting pipe nipple or riser shall be galvanized steel or schedule 80 PVC plastic.

5.23 Unions shall conform to the requirements of Fed. Spec. WW-U-531, Type B.

5.24 Miscellaneous Items.

5.24.1 Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be the double flattened strap type. Clamps shall have a galvanized malleable iron body with cadmium plated straps and nuts. Clamps shall have rubber gasket cemented to the body.

5.24.2 Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 pounds per square inch.

5.24.3 Tapping sleeve(s) of the size(s) indicated for connection to existing main shall be the cast iron, split-sleeve type with flange on the outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 200 pounds per square inch. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets, and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve.

5.25 Irrigation Filter (main line) shall be a centrifugal action filter which forces incoming water through a directional nozzle plate onto the inside of the filter screen. Debris is forced down in rotating motion into a holding basin at the bottom of the filter and by opening a flush valve, the particles may be removed. The Contractor shall install the irrigation filter according to the manufacturer's requirements and as shown on the drawings.

5.25.1 Filter Housing shall be constructed of ten gage steel, epoxy coated, and welded into a wye configuration. A threaded 1/4 inch pressure tap shall be welded into the upstream and downstream piping for connection of pressure gages.

5.25.2 Filter Screen shall be 150/mesh stainless steel.

5.25.3 Filter Flush Valve shall be a "ball" type made of brass.

5.26 Pipe Straps shall conform to the applicable requirements of MSS SP 58 and SP 69.

## 6. INSTALLATION.

6.1 General. Unless otherwise specified, installation of drip system components and sprinklers, backflow prevention units, control valves, moisture probes, irrigation station components, and boxes shall conform to the installation details as shown on the project plans.

6.2 Handling. Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material at no additional cost to the Government.

6.3 Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutters shall be used when practicable.

6.3.1 Plastic Pipe shall be cut square and all burrs, particles and curls shall be removed.

6.4 Placing and Laying. Pipe and accessories shall be carefully lowered into the trench. Under no circumstances shall any of the materials be dropped or dumped into the trench. The full length of each section of pipe or dripline shall rest solidly upon the pipe or dripline bed, with recesses excavated to accommodate joints. Pipe or dripline that has the grade of joint disturbed after laying shall be taken up and relaid. Pipe or dripline shall not be laid in water or when

trench conditions are unsuitable for the work. Water shall be kept out of the trench until jointing is completed. When work is not in progress, open ends of pipe or dripline, fitting, and valves shall be securely closed (water tight) so that no trench water, earth, or other substance will enter the system. Dripline shall not be placed with kinks or sharp bends.

6.4.1 Plastic Pipe shall be installed in accordance with the procedures recommended in ASTM D 2774 and as herein specified.

6.5 Tracer tape or wire shall follow all plastic main line pipe lines and terminate in the box with the valve that controls these main irrigation lines. Attach a plastic label with the designation "Tracer Tape" to the tape at each box.

6.6 Galvanized Steel Pipe And Ductile Iron Pipe. Threaded joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

6.7 Insulation Joints shall be installed in accordance with recommendations of the manufacturer. Use teflon tape on all threaded connections between P.V.C. and metal, and metal to metal.

6.8 Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

6.9 Pipe Sleeves shall be installed with a minimum of off-set at the joints to permit easy installation and removal of the irrigation lines. All main and lateral lines shall be installed in sleeves (one line per sleeve) under paved areas, spillways, and other structures. Sleeves shall extend at least 12 inches beyond the edges of the pavement or structure. Sizes of sleeves shall be as follows unless otherwise indicated on drawings.

Pipe Size (inches)	Minimum Sleeve Size (inches)
1/2	2
3/4	2-1/2
1, 1-1/4 and 1- 1/2	3
2 and 2-1/2	4
3 and 4	6
6	8
8	12
10	14
12	16
14	18

6.10 Setting of Valves, and Boxes. Valves and valve boxes shall be installed where shown or as directed, and shall be set plumb. Valve boxes shall be centered on the valves. Valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve or meter box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valves shall have the interiors cleaned of all foreign matter before installation.

6.11 Reaction Backing (Thrust Block). Thrust blocks shall be concrete mixed not leaner than 1 cement: 2-1/2 sand, 5 gravel. Blocks shall be placed between solid ground and the fitting to be anchored. The area of bearing shall be as indicated on the plans or as approved. Contractor shall submit certification of concrete mix in accordance with SECTION: CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION. Install thrust blocks as per detail on project plans.

6.12 Remote Control Valves. Install remote control valves in locations as shown on the drawings, with a cover of 6 inches maximum over top of flow control stem. Install a union on downstream side of all valves not provided with a union type connection. Fit with valve box and lockable or boltable cover. Top of valve box shall be 1/2-inch above finish grade.

6.13 Remote Control Wiring.

6.13.1 Remote Control and Tensiometer Wiring (For Systems Off Controllers B, C, E, H, N, & P) shall be type UF. Connections of wiring, other than in the controller housing, shall be made with epoxy encapsulated connectors. Where more than one wire is placed in trench, the wiring shall be taped together at maximum intervals of 30 feet, and taped to the mainline pipe. Install wire within PVC conduit at all locations where installed within pipe sleeves. Use different color low voltage control wire for each irrigation controller. Use with common wire for all controllers. Wire splices shall not be permitted between the RCV and the controller.

6.13.2 Wire for Remote Controller Valves and Tensiometers (For Systems Off Controllers A, D, F, G, Z, & Y). For wiring connections from remote control valve assemblies (RCV) and tensiometer assemblies to irrigation controller panel use type THWN/THHN dual rated wire. All wiring shall be installed in rigid PVC conduit, Class 125 unless otherwise specified on the plans. Use "Duct-Seal at conduit pipe connections. Pullboxes and junction boxes shall be located every 200 feet and at every 90° change in pipe direction and will be clearly marked as appropriate. All wiring connections exposed to moisture shall be waterproofed using components such as 3M DBY Splice Kit (Scotch Lock Y Electrical Spring Connector) or Rain Bird ST-03 Snap-Tite, UL Connectors and PT-S5 Sealer. Use different color control wire for each irrigation controller. Use with common wire for all controllers. The number of controller wires per conduit shall be in accordance with NEMA standards.

6.14 Automatic Irrigation Controllers. Controllers shall be mounted on embeds in approved enclosures as per manufacturer's recommendations. Connection to electrical panels shall be as shown on project plans. Control and sensor wire connections shall be made within the pedestal or head of the controller. All wires shall be dressed and tiwrapped to provide a clean and neat package for task of maintenance. The Contractor shall be responsible for connection of valve and sensor wires as indicated on the project drawings, and for numbering and documenting their location by controller and terminal connection. Electrical wiring shall be in rigid conduit from controller to electrical panel as provided under SECTION: ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. The work under this section shall include all wiring to the panels or elsewhere as required, in order to complete the installation of the control system. The manufacturer shall provide evidence of complete service capabilities and the location of such facilities. The manufacturer shall provide, for consideration and budgeting purposes, an extended warranty agreement covering all parts and labor. The

manufacturer shall provide adequate training of individuals identified as computer operators at its training facility or at the central installation as requested by the Contracting Officer. The manufacturer shall also provide a standard operating procedure/O&M Manual.

6.15 Controller Enclosures shall be installed as shown on plans.

6.16 Tensiometer (Moisture Probe) Installation. Tensiometers shall be installed in concrete or plastic valve access boxes as follows:

a. One 36-inch probe for each system using a probe (as shown on the project plans) and served off controllers B, C, E, H, N & P.

b. Two probes within one access box for each system using probes (as shown on the plans) and served off controllers A, D, F, G, Y, and Z. C probes are to be installed within 60-feet of designated remote control valves, at the top of channel slopes, as shown on plans. The exception to this shall be turf areas served off controllers B, E, C, H, N, & P, where probes shall be placed at the bottom of channel slopes (in the channel invert) in turf area immediately downslope from designated valve. Probes used in systems off controllers B, E, C, H, N, & P, shall be wired through designated remote control valve as shown on plans. Probes used on systems off controller A, D, G, F, Z, & Y, shall be wired directly to the controller. Probes shall be placed tip down in the ground to sense at 1/2 of the root zone depth. Use No. 14 (minimum) wire for all wire connections. Use "Pen-Tite" type wire connectors. Leave a 30-inch wire expansion coil within the access box. The Contractor shall secure the services of the manufacturer on site for installation instructions. Programming probes to the controller shall be as per the directions of the Contracting Officer.

6.17 Fertilizer Injector System. All components of the fertilizer injection system shall be installed as per the manufacturer's recommendation. The Contractor shall arrange for factory technical people to supervise this installation, at no additional cost to the Government.

6.18 Solution Tank. All components of the solution tank shall be installed as per the manufacturer's recommendation. The Contractor shall arrange for factory technical people to supervise this installation, at no additional charge to the Government. The fertilizer injection system shall be furnished as a "package" system; from a single source vendor. This vendor shall provide on-site technical assistance for system installation, start-up and calibration. Final solution strength and rate of metering shall be determined by the Contracting Officer.

6.19 Connections to Existing Water Line.

6.19.1 Water Meters and their installation shall be as per local water purveyors (as indicated below) specifications. Size shall be as indicated in the plans, except that all meters shown as 8 inch size (i.e., line size) shall be changed to 6 inch turbine meters. Water Meters shall be supplied at points-of-connection as follows:

At Sweetwater Avenue - By City of Glendale  
At 59th Avenue - By City of Glendale  
At Thunderbird Road - By City of Glendale  
At Hearn Road - By City of Glendale  
At 67th Avenue - By City of Glendale  
At 71st Avenue - By City of Glendale  
At 75th Avenue - By City of Peoria

6.19.2 Costs for meters and securing of permits for connections to existing mains/facilities shall be paid for by the Contractor. The Contractor shall adhere to requirements of the City of Glendale "Design Requirements Booklet" for P.O.C. requirements within that city. Contact:

City of Glendale,  
Department of Utilities,  
5850 West Glendale Avenue,  
Glendale, Arizona 85301  
(602) 931-5561

and

City of Peoria,  
Department of Public Works,  
8320 West Madison,  
Peoria, Arizona 85345  
(602) 878-6499

6.19.3 Connection to Electrical Utility. The Contractor shall make all necessary arrangements as specified in SECTION: GENERAL REQUIREMENTS for electrical service connections. Costs of installation and connections shall be paid by the Contractor. P.O.C. Arizona Public Services, Metro Engineering Service, 2121 W. Cheryl Drive, Phoenix, AZ 85036, Mr. Ernest Cota, (602) 271-3576 and Flood Control District of Maricopa County, 3335 W. Durango Street, Phoenix, AZ 85009, Mr. John E. Rodriguez, (602) 262-1501.

6.20 Contractor is to bore under existing spillway structures where irrigation lines are shown to cross on project plans.

## 7. TESTS.

7.1 After completion of the piping system and prior to backfilling and the installation of the sprinkler heads the entire system shall be tested for leaks and thoroughly flushed under pressure to remove any dirt, scale or other material. Lines shall be tested at 125 psi for three hours duration. Cracked or defective pipe, fittings, or accessories disclosed in the pressure test shall be replaced by the Contractor with sound material at no additional cost to the Government, and the test shall be repeated until results are satisfactory to the Contracting Officer.

7.1.1 No line shall be covered until inspection and approval has been given by the Contracting Officer.

7.1.2 Testing of plastic pipe shall not be done until all joints have had at least 24 hours to set and cure. During cold weather, 48 hours elapsed time shall be allowed for setting prior to testing. No water under pressure shall come in contact with any joint during the specified curing period. In hot weather, water shall not be permitted to stand in pipes until after backfilling is completed. Water used in testing shall be drained from pipes after completion of testing.

7.2 Coverage Test. When the irrigation system is completed the entire system shall be adjusted and operated to demonstrate that the water coverage is complete and adequate and that the system conforms to the requirements of the plans and specifications. All deficiencies and inadequacies resulting from defective or inadequate materials and/or workmanship shall be corrected at no additional cost to the Government. In the event any modifications to the system or deviation from the approved plans and specifications are directed, an adjustment in contract price will be made.

8. DISINFECTION. The completed line from the backflow prevention unit to the connection to the existing water line shall be disinfected as prescribed by AWWA C 651.

9. TOOLS. Three sets of special wrenches for removal and/or installation of sprinkler heads shall be provided at locations designated by the Contracting Officer.

10. CLEANUP. Upon completion of the installation of the irrigation system and appurtenances, all debris and surplus materials resulting from the work shall be removed.

11. VARIATION IN ARRANGEMENT OF SPRINKLERS AND EMITTERS (DRIP LINE) from those shown on drawings will be permitted. If such variation is made, the Contractor shall submit a shop drawing for approval in accordance with the Special Clauses. If any conflicts occur necessitating departures from the contract drawings, details of departures, hydraulic calculations and reasons shall be submitted as soon as practicable for written approval of the Contracting Officer. Hydraulic calculation shall include application rate per hour, maximum triangular spacing of heads for design flow rate and pressure, overlap including wind loss allowance and friction loss thru pipe fittings, valves and accessories.

11.1 Irrigation Lines and Appurtenances are shown schematically on the project plans. Prior to installation, the Contractor shall furnish shop drawings, at a scale acceptable to the contracting officer, showing the intended dimensioned location of all main and lateral lines (other than dripline), and all other irrigation appurtenances (other than sprinkler heads and dripline emitters). These plans, if in accordance with the requirements of the Special Provisions, may be submitted as "as-built drawings".

12. SUBMITTALS AND GUARANTEE. The manufacturer's literature on the following materials and equipment to be furnished under this specification shall be submitted for approval with a guarantee against defective materials, design and workmanship for a period of one year from the date of acceptance thereof, or beneficial use or final acceptance, whichever is earlier:

Automatic controller, enclosure and any other components listed herein and  
on the project drawings  
Backflow prevention units  
Bubblers  
Control Valves  
Emitters and drip line  
Fertilizer injector unit  
Flow sensor  
Filter units  
Flush valves  
Gate valves  
Ball valves (electric actuators)  
Pressure sensor  
Pressure regulator  
PVC pipe and fittings  
Quick coupling valves and keys  
Sprinklers  
Tensiometers  
Water meters  
Air Relief Valves  
Air Vent Valve/Vacuum Breakers

\* \* \* \* \*

## SECTION 2S

### PAVEMENT MARKINGS

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.).

TT-B-1325	Beads (Glass Spheres); Retro-Reflective
TT-P-85 E	Paint, Traffic and Airfield Marking, Solvent Base
TT-P-115 F	Paint, Traffic (Highway, White and Yellow)

2. MATERIALS. Paint shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, formulation number and directions, all of which shall be plainly legible at time of use. The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of six months.

2.1 Paint. Paint for pavement shall conform to Fed. Spec. TT-P-115 or TT-P-85 and color shall be white unless otherwise specified. Paint shall be suitable for use over all types of asphaltic-concrete surfaces.

2.2 Reflective media for pavement shall conform to Fed. Spec. TT-B-1325, Type I, gradation A.

3. EQUIPMENT. All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

4. SURFACE PREPARATION. New pavement surfaces shall be allowed to cure for a period of not less than 30 days before application of marking materials. All surfaces to be marked shall be thoroughly cleaned before application of the paint. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed.

5. APPLICATION.

5.1 Rate of Application. Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

5.2 Paint. Paint shall be applied to clean, dry surfaces, and unless otherwise approved, only when air and pavement temperatures are above 40 degrees F. and less than 95 degrees F. Paint temperature shall be maintained within these same limits. Paint shall be applied pneumatically with approved equipment at rate of coverage specified herein. The Contractor shall provide guidelines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

\* \* \* \* \*

SECTION 2T

CONCRETE INTERLOCKING PAVING STONE

Index

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 The American Society for Testing and Materials (ASTM).

C 33-86	Concrete Aggregates
C 140-75 (R-1980)	Method of Sampling and Testing Concrete Masonry Units
C 936-82	Solid Concrete Interlocking Paving Units

2. GENERAL. Paving units shall be precast interlocking paving units produced by a manufacturer regularly engaged in the manufacture of paving units conforming to the requirements specified herein. The Contractor selected to install the paving stones shall have at least five years experience in the installation of interlocking concrete paving units.

3. SUBMITTALS.

3.1 Certificates of Conformance. Before delivery of the paving units, notarized certificates attesting that materials meet the requirements specified shall be submitted in accordance with the SPECIAL CLAUSES.

3.2 Certified Laboratory Test Reports. Certified copies of the reports of all tests specified herein and required in referenced publications shall be submitted to the Contracting Officer's Representative.

3.3 Samples. Representative samples of paving stone shall be submitted to the Contracting Officer's Representative for approval. Samples shall contain at least 5 paving stones of each style, color, and texture to be supplied for the work specified.

4. DELIVERY, STORAGE, AND HANDLING. Handle, store, and protect paving units in a manner to avoid chipping, breakage, discoloration, or contact with contaminating materials and exposure to the elements.

5. MATERIALS.

5.1 Paving units shall be made from Portland cement and normal weight aggregates in accordance with the requirements of ASTM C 936.

5.2 Color. The color of the paving units shall be as indicated on the drawings. Coloring pigment shall be non-fading and shall conform to the requirements of the SECTION: CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION.

5.3 Sand. Sand for laying course shall conform to the requirements of ASTM C 33 for washed concrete sand.

6. SAMPLING AND TESTING. All sampling and testing shall be the responsibility of the Contractor.

7. PREPARATION OF SAND LAYING COURSE.

7.1 The sand laying course shall be spread evenly over the area to be paved and then screeded to a level that will produce one inch thickness when the paving units have been placed and vibrated.

7.2 The finished sand laying course shall be protected from any damage.

8. PLACING.

8.1 Paving units shall be laid in the pattern, as indicated, and the joints between units will not exceed 1/8 inch.

8.2 Gaps at the edge of the paver surface shall be filled with standard edge unit or with units sawcut to fit. Sawcut edges shall be clean, true, and sharp. Whenever possible, units less than 1/3 of original dimension shall not be used.

8.3 Paving units shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force with the surface clean and joints open.

8.4 After vibration, clean sand shall be spread over the paving stone surface, allowed to dry, and vibrated into joints with additional vibrator passes and brushing so as to completely fill joints.

8.5 Surplus sand shall be swept from the surface to insure that joints have been completely filled.

\* \* \* \* \*

SECTION 3A

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 Concrete Institute (ACI) Standard.

318-83	Building Code Requirements for Reinforced Concrete
SP-66	ACI Detailing Manual - 1980

1.2 American Society for Testing and Materials (ASTM) Publication.

A 185-85	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
A 615-85	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C 33-86	Concrete Aggregates
C 94-86	Ready-Mixed Concrete
C 150-85a	Portland Cement

1.3 U.S. Department of Agriculture.

Handbook 18 - Soil Survey Manual

2. GENERAL. The work shall be in conformance with ACI 318, part entitled, "Construction Requirements," except as specified herein. Concrete shall conform to ASTM C 94, using a maximum nominal aggregate size of 3/4-inch. All concrete not specified in other sections shall conform to this section.

3. STORAGE. Materials shall be stored so as not to deteriorate or become contaminated.

#### 4. MATERIALS.

4.1 Aggregate. Aggregate shall conform to ASTM C 33.

4.2 Anchorage Items. Anchorage items for anchoring work of other trades to concrete shall be of standard manufactured item of the types to engage with anchors provided and installed under other sections.

4.3 Concrete Materials. Concrete materials shall conform to ASTM C 94, and shall include Portland cement conforming to ASTM C 150, Type II, low alkali. Only one brand of any one type of cement shall be used for exposed concrete surfaces of any individual structure.

4.4 Curing Materials. Curing materials shall be impervious sheet or membrane-forming curing compound. Impervious sheet shall be white opaque polyethylene 4 mils thick, waterproof kraft paper, or polyethylene-coated burlap. Membrane-forming curing compound shall be of commercial formulation, sprayable, nontoxic, and will form a film highly resistant to moisture loss from concrete while curing and will dry within 4 hours. Compound shall be clear with fugitive dye, resin-base, or chlorinated-rubber-base-type.

4.5 Expansion Joint Filler Strips, Premolded. Expansion joint strips shall be nonextruding, resilient bituminous or nonbituminous type for use in concrete paving or construction, 3/8-inch thick minimum unless noted otherwise on the drawings.

4.6 Form Coating. Form coating shall be nonstaining form oil or form release agent that will not deleteriously affect concrete surfaces nor impair subsequent applications.

4.7 Form Materials. Form materials shall be plywood or hardboard especially made for concrete form use or other materials that will produce the specified finishes without adversely affecting the concrete surfaces.

4.8 Form Liners. Form liners shall be a plasticized polyvinyl chloride bonded to 3/4 inch by 4 feet by 8 feet plywood.

4.8.1 Form Release Agent shall be a colorless agent which will not stain concrete, absorb mixture, or impair natural bonding or color characteristics of coating intended for use on concrete.

4.9 Form Ties. Form ties shall be metal, factory-fabricated removable or snap-off, that will not leave holes less than 1/4 inch nor more than one inch in diameter and not more than one inch in depth. That portion of the tie remaining permanently in the concrete shall not project beyond the surface of the concrete and shall be recessed at least 1 inch from any concrete surface that will be exposed, painted, dampproofed, or will receive direct applications of plaster.

4.10 Joint Sealant. Joint sealant shall be hot- or cold-applied, made specifically for sealing joints in concrete against moisture infiltration.

4.11 Colors. Colors of pigmented concrete shall be considered satisfactory based on the comparative analysis of color produced from test panel(s) in accordance with paragraph: TEST PANELS, and Munsell Color samples in accordance with

U.S. Department of Agriculture Handbook 18 - Soil Survey Manual. Color of concrete shall conform to Munsell Color Number 10YR5/3 or 10YR7/3 as described below with respect to hue, value, and chroma. Evaluation of color shall be made within the time limits prescribed in paragraph: TEST PANELS. Color admixture shall be certified to be non-fading by manufacturer.

4.12 Elements to be colored. The following concrete elements will be colored as indicated. The low flow channel, the headwalls of the side drains and the side drains exposed to view will be colored 10YR7/3. The slab at the Irrigation station and the concrete fence posts will be colored 10YR5/3.

4.13 Color Admixture. Color admixture for concrete shall be the product of a manufacturer regularly engaged in the production of colored admixtures for concrete that has a history of at least 2 years of use of the material in a similar environment without substantial fading or deleterious effects on the structural qualities of the concrete. Color admixture must be capable of evenly distributing the color throughout the concrete without segregation or irregular concentration of color.

4.14 Test Panels. After shop drawings have been approved, sample panels and posts shall be prepared for each colored concrete and each special surface treatment as described hereinafter with a minimum dimension of 6 feet by 6 feet by 6 inches thick. Panels will be either horizontal or vertical depending on how the elements they represent will be placed in the final construction. Some finishes and forming methods may require both alternatives. Sample panels will be required for all surfaces described in paragraph: FINISHES FOR CONCRETE OTHER THAN SLABS. At least three sample posts will be delivered. The test panels shall be placed in the presence of the Contracting Officer, and the mix design shall conform in all respects to the mix proposed for use in the project. The Contractor shall also overlay on an area of the test panel not less than 12 inches square a dry-pack mortar sample using the same mix intended for use in setting of base plates for concrete fence posts. The concrete and mortar shall be finished, protected, and cured adjacent to the site of proposed construction using methods proposed for use by the Contractor on the features of the project which will receive colored concrete. Only one half of the panel area will be cured with curing compound. The remaining portion will not be cured. The test panel shall not be protected from the effects of the sun while curing. Color comparison as a basis for acceptance of color shall not be made in less than 14 days after placement of concrete for the test panel. Wetting of the concrete shall not be permitted within a period of 7 days prior to making color comparisons. No concrete shall be scheduled for placement within 30 days of construction of the test panel, and no concrete shall be placed prior to demonstrated compliance with the color requirements of these specifications. When, in the opinion of the Contracting Officer, the test panel does not conform to the color requirements herein, the Contractor shall continue to place additional test panels at no additional cost to the Government until a final mix design has been developed that produces concrete conforming to the color requirements herein. Approval of test panel color and mix design shall not relieve the Contractor from the requirements of these specifications. The Contractor shall not remove the test panel until concrete work is complete. At completion of concrete work, the test panel shall be considered to be scrap material and disposed of in accordance with SECTION: GENERAL REQUIREMENTS.

4.15 Reinforcing Bars. ASTM A 615, Grade 60.

4.16 Welded Wire Fabric. ASTM A 185.

5. CONCRETE QUALITY. Proportioning of concrete mixes to meet the requirements specified below shall be the Contractor's responsibility.

5.1 Compressive Strength. Compressive strength in 28 days shall be 3,000 psi for reinforced concrete and 3,000 psi for nonreinforced concrete.

5.2 Entrained-Air Content. Entrained-air content of concrete shall be maintained at 3 to 5 percent by volume of concrete.

5.3 Slump. Slump shall be 2 to 4 inches for walls and one to three inches for all other work. If the Contractor elects to place concrete by pump, the concrete will have a maximum slump of 6 inches and will fall within a range of  $\pm 1\frac{1}{2}$  inches of the selected slump.

5.4 Tests for Air Entrainment and Slump. Tests shall be taken at the time concrete is deposited in the forms.

6. FORMWORK. Formwork shall provide for concrete conforming accurately to the indicated shapes, lines, dimensions, and with surfaces free of offset, waviness, or bulges. Where surfaces are to be exposed or painted, panels shall be manufacturer's stock size material, using smaller panels cut to required dimensions only where required by openings and joints. Panel joints in exposed or painted work shall occur at control joints, including alignment with masonry control joints and construction joints. Exposed corners shall be chamfered, beveled, or rounded by moldings placed in the forms. Surfaces shall be thoroughly cleaned and coated before each use. Forms shall be removed at a time and in a manner that will not injure the concrete.

6.1 Formwork for Fence Posts.

6.1.1 The following special requirements shall apply to formwork for the concrete posts used in the picket fence construction. The form facing material shall be composed of new, well-matched tongue-and-groove or shiplap lumber; new plywood panels conforming to NBS PS-1 grade B-B concrete form Class I; tempered concrete hardboard or steel. Steel lining on wood sheathing will not be allowed.

6.1.2 All bolts, wires, and rods shall be clipped and recessed. All holes, honeycomb, rock pockets, and other surface imperfections shall be cleaned out, thoroughly moistened and carefully patched with mortar. Mortar shall be composed of 1 part cement and 2 parts fine sand. Additionally, the mortar shall be colored to match the color used in manufacture of the posts. The surface shall then be promptly covered with polyethylene film, wet burlap or cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive, or other suitable means. Only white polyethylene film for covering will be acceptable.

6.1.3 When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such a lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. The grout shall be colored as required to match the color of the

surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform surface.

7. REINFORCEMENT. Reinforcement detailing and placement shall conform to ACI SP-66 and ACI 318. Reinforcement shall be interrupted 2-inches clear on each side of joints in slabs on grade and perimeter joints. Wire-mesh reinforcement shall be continuous between joints in slabs on grade. Laps shall be at least on full mesh plus 2 inches; staggered to avoid continuous lap in either direction; and securely wired or clipped units in a manner that will support the mesh at the minimum height indicated.

8. INSTALLATION OF ANCHORAGE ITEMS. Anchorage items shall be of number, size, and location to insure sufficient anchorage for purpose intended.

9. JOINTS.

9.1 Perimeter Joints. Joints between interior slabs on grade and vertical surfaces shall be of 30-pound asphalt-saturated felt, or expansion joint material, extending full slab depth.

10. PLACING. Concrete footings and exterior slabs shall be placed upon clean undisturbed surfaces free from frost, ice, and water. Dry or pervious surfaces receiving concrete shall be covered with impervious sheet materials. Concrete may be placed directly on impervious surfaces that are thoroughly moistened but not muddy. Concrete shall be protected from freezing. Concrete to receive other construction shall be screeded to the proper level.

11. CONSOLIDATION OF CONCRETE. Consolidation of concrete shall be with internal concrete vibrators supplemented by handspading, rodding, and tamping. Vibrating equipment shall be adequate to thoroughly consolidate the concrete.

12. INTERIOR SLABS ON GRADE. Concrete shall be compacted, screeded to grade, and prepared for the specified finish. Contraction joints shall be located as indicated on the plans, true to line, 1/8-inch wide, and of depth equal to approximately 1/4 of the slab thickness. Joints shall be sawed or formed by inserting fiberboard strips of the required dimensions after placing concrete. Joints in permanently exposed slabs shall be filled with joint sealant.

13. FINISHES FOR CONCRETE OTHER THAN SLABS. Fins and loose material shall be removed. Unsound concrete, voids over 1/2 inch in diameter, and tie-rod and bolt holes shall be cut back to solid concrete, reamed, brush-coated with cement grout, and filled solid with a stiff Portland cement-sand-mortar mix. Patchwork shall finish flush with adjoining concrete surfaces and where exposed, shall match adjoining surfaces in texture and color. Patchwork shall be completed not less than 24 hours after forms have been stripped and shall be cured in accordance with paragraph: CURING.

13.1 Exposed Aggregate Finish.

13.1.1 Leave form work in place until concrete has attained minimum compressive strength of 1800 psi.

13.1.2 Immediately after removal of form work, wash retarded concrete surfaces with water and scrub with stiff bristle brush exposing aggregate.

13.2 Rough Sawn Lumber Finish. Walls to be exposed to view and specified to receive a rough sawn lumber finish shall be formed by using a plasticized polyvinyl chloride form liner. Place and remove form liner in accordance with manufacturer's recommendations.

14. CONCRETE SLAB FINISHES. Slabs shall be finished to a true plane with no deviation exceeding 1/8 inch when tested with a 10-foot straightedge. Surfaces shall be pitched to drains. Surfaces shall be screeded and floated to the required finish level with no coarse aggregate visible before finishing as specified below.

14.1 Monolithic Finish. Monolithic finish shall be given to slabs unless otherwise specified. After the surface moisture has disappeared, floated-surfaces shall be steel-troweled to a smooth, even, dense finish free from blemish, including trowel marks.

14.2 Nonslip Finish. Nonslip finish shall be given to stair treads, landings, exterior building entrances, vestibules, and other surfaces so indicated by brooming with a fiber-bristle brush in a direction transverse to that of main traffic.

15. CURING shall start as soon as free water has disappeared from concrete surfaces after placing and finishing. Curing materials shall be applied and maintained so as to protect the concrete from moisture loss for 7 days. Curing shall be accomplished by impervious sheet or membrane-forming curing compound. Concrete surfaces shall be thoroughly wetted before covering with impervious-sheet materials. Membrane-forming curing compound shall be applied with mechanical spraying equipment at a coverage of not more than 300 square feet per gallon. Surfaces of compound damaged during curing shall be resprayed. The compound shall not be used on surfaces to receive floor hardener or applications dependent on adhesion or bonding, except that resin-base or chlorinated-rubber-base compounds may be used on floors receiving resilient flooring; nor shall it be used on surfaces to be painted or surfaces to receive bituminous roofing or waterproofing.

\* \* \* \* \*

SECTION 4A

REINFORCED MASONRY

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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 Specifications (Fed. Spec.).

SS-S-1996

Sealer, Water and Weather Resistant,  
for Asphalt, Concrete, and Masonry  
Surfaces

1.2 U.S. Army Corps of Engineers Publication.

CRD-C 619-81

Grout Fluidifier

1.3 American Concrete Institute (ACI) Standard.

SP-66

ACI Detailing Manual - 1980

1.4 American Society for Testing and Materials (ASTM) Publication.

A 82-85

Steel Wire, Plain, for Concrete  
Reinforcement

A 116-81

Zinc-Coated (Galvanized) Steel Woven  
Wire Fence Fabric

A 615-85

Deformed and Plain Billet-Steel Bars  
for Concrete Reinforcement

C 5-79

(R 1984)

Quicklime for Structural Purposes

C 33-86

Concrete Aggregates

C 39-86

Compressive Strength of Cylindrical  
Concrete Specimens

C 90-85

Hollow Load-Bearing Concrete Masonry  
Units

C 91-87a

Masonry Cement

C 94-86a	Ready-Mixed Concrete
C 140-75 (R 1980)	Sampling and Testing Concrete Masonry Units
C 144-84	Aggregate for Masonry Mortar
C 150-85a	Portland Cement
C 207-79 (R 1984)	Hydrated Lime for Masonry Purposes
C 270-86a	Mortar for Unit Masonry
C 331-81	Lightweight Aggregates for Concrete Masonry Units
C 404-85	Aggregates for Masonry Grout
C 426-70 (R 1982)	Drying Shrinkage of Concrete Block
C 641-82	Staining Materials in Lightweight Concrete Aggregates

2. QUALIFICATIONS OF TESTING AGENCY. The Contractor shall retain at his expense a testing laboratory to perform the laboratory testing and sampling specified herein. The laboratory shall have all facilities required to perform the specified sampling and testing. Personnel employed in the testing shall have had previous experience in sampling and testing the materials involved. Information regarding testing laboratories and qualifications of testing personnel shall be submitted to the Contracting Officer for approval.

### 3. DEFINITIONS.

3.1 Concealed masonry surfaces are defined as follows. Surfaces of foundation walls against which backfill is placed; surfaces covered by furring and wallboard, or stucco.

3.2 Exposed masonry surfaces are defined as all other masonry surfaces including those to be painted.

3.3 Grout Lift and Grout Pour. A grout lift is defined as the layer of grout placed in a single continuous operation. A grout pour is defined as the entire height of grout fill placed in 1 day and is composed of a number of successively placed grout lifts.

### 4. SUBMITTALS.

4.1 Samples. The following samples shall be submitted for approval before work is started.

- a. Anchors and Ties - Two of each type proposed for use.

b. Concrete Masonry Units - Shapes, sizes, and kinds in sufficient numbers to show full range of color and texture.

c. Joint Reinforcement - One piece of each type of reinforcement, including corner and wall intersection pieces, showing at least two cross joints.

4.2 Certificates of Conformance or Compliance. Before delivery of the following materials, notarized certificates attesting that materials meet the requirements specified shall be submitted in accordance with the SPECIAL CLAUSES.

a. Concrete Masonry Units

b. Joint Reinforcement

c. Reinforcing Bars

4.3 Certified Laboratory Test Reports. In addition to the submittal of certificates specified herein, certified copies of the reports of all tests listed below and required in referenced publications for the following materials shall be submitted. The testing shall have been performed by an approved independent laboratory acceptable to the Contracting Officer within 6 months of submittal of reports for approval. Test reports on a previously tested material shall be accompanied by notarized certificates from the manufacturer certifying that the previously tested material is of the same type, quality, manufacturer, and make as that proposed for this project.

a. Concrete Masonry Units - Linear drying shrinkage, compressive strength and absorption of each type of unit and popout and staining properties of lightweight aggregates used in the units.

b. Cement - Certified mill test reports of each mill lot.

4.4 Shop Drawings. The following shop drawings shall be submitted for approval prior to delivery of the materials to the jobsite.

a. Reinforcing Bars. Shop drawings for reinforcing bars shall include plans, elevations, and details showing treatment of reinforcing at turns and offsets; intersections of similar and dissimilar materials; tops, bottoms, and ends of walls; wall openings and laps. Shop drawings shall also show details of positioning devices used to hold the vertical reinforcing bars in the proper position within the cells.

5. DELIVERY, STORAGE, AND HANDLING. Handle, store, and protect masonry units in a manner to avoid chipping, breakage, or contact with the soil or contaminating materials and exposure to the elements. Concrete masonry units delivered to the job site shall have a moisture content specified in ASTM C 90. Keep anchors, ties, and joint reinforcement free of rust. Steel reinforcing bars shall be free of loose scale and rust. Deliver cement and lime in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Store cementitious materials in dry, weathertight sheds or enclosures or under watertight tarpaulins. Store and handle cement in a manner which will prevent the inclusion of foreign materials and damage by water or dampness.

## 6. ENVIRONMENTAL CONDITIONS.

6.1 Hot Weather Installation. Newly constructed masonry shall be kept damp for at least 5 days with a nozzle regulated fog spray sufficient to moisten faces of the masonry but not of such quantity as to cause water to flow down over the masonry.

6.2 Cold Weather Installation. Materials to be used and built upon shall be free from ice and snow, and shall not be in a frozen condition. Do not lay masonry during temperatures below minus 10 degrees F. unless authorized in writing. Before erecting masonry during temperatures below 40 degrees F., submit for approval a written statement giving the methods proposed to heat the masonry materials and to protect the masonry from freezing. Keep masonry units completely covered and free from frost, ice, and snow at all times and maintain them at a minimum temperature of 32 degrees F. when laid. Maintain temperature of mortar and grout between 40 degrees F. and 120 degrees F. by heating mixing water and/or sand. Temperature of mixing water or of water and sand introduced to cement shall not exceed 160 degrees F.

## 7. MATERIALS.

7.1 General. The source of materials which will affect the appearance of the finished work shall not be changed after the work has started. Wire gages specified herein are American Steel Wire Gages. Materials shall conform to the respective specifications and other requirements specified below.

7.2 Admixtures. The high-lift grout admixture shall conform to CRD-C 619 and in addition shall produce an expansive action in the plastic grout sufficient to offset initial water loss shrinkage and promote bonding of the grout to all interior faces of the masonry units. Other admixtures may be used in mortar or grout provided that the admixture does not affect bond or compressive strength of mortar or grout designed without the use of the admixture. Anti-freeze compounds shall not be used. The admixtures shall not contain calcium chloride salts or any other chemical that will adversely affect metals or the coatings of metals embedded in the mortar or grout.

7.3 Aggregate for Mortar. ASTM C 144, except that not less than 3 percent nor more than 15 percent shall pass the No. 100 sieve. Aggregate used in mortar for joints 1/4-inch or less shall have 100 percent passing the No. 8 sieve with 10 percent being retained on the No. 16 sieve.

7.4 Aggregate for Grout.

7.4.1 Fine Aggregate. ASTM C 404 or C 144.

7.4.2 Pea Gravel. Clean or washed gravel conforming to ASTM C 404, except that 100 percent shall pass the 3/8-inch screen and not more than 5 percent shall pass the No. 8 sieve.

7.4.3 Coarse Aggregate. ASTM C 404, size No. 8 or ASTM C 33, 3/4-inch maximum size as indicated in Grading Table for coarse aggregates.

## 7.5 Anchors, Ties, and Centering Devices.

7.5.1 Wire Devices. Factory fabricated from steel wire conforming to ASTM A 82. Wire devices in walls shall be formed from wire that has been zinc coated in accordance with ASTM A 116, Class 3.

7.5.2 Centering clips shall be formed from not lighter than 9 gage wire. Clips shall be of a design that will prevent displacement of the reinforcing bars during the course of construction.

## 7.6 Cement.

7.6.1 Portland Cement. ASTM C 150, Type II, including the requirements for low alkali content.

## 7.7 Concrete Masonry Units.

7.7.1 Aggregates. ASTM C 33 or C 331 except as follows.

7.7.1.1 Grading of aggregates as stipulated in ASTM C 33 and testing of lightweight aggregates for drying shrinkage as stipulated in ASTM C 331 will not be required.

7.7.1.2 Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641. By visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification; by chemical analysis method and reported as ferric oxide, the iron stain deposited on the filter paper from 200-gram sample shall not exceed 1.2 milligrams of ferric oxide.

7.7.2 The linear drying shrinkage of concrete masonry units shall not exceed 0.065 percent when tested in accordance with ASTM C 426. Maximum moisture content percentage of the total absorption will be in accordance with ASTM C 90.

7.7.3 Kinds and Shapes. In addition to the requirements specified above, concrete masonry units of the various kinds shall conform to the specifications referenced below. Units shall include closer, jamb, header, and bond beam units and special shapes and sizes to complete the work as indicated. All units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

7.7.3.1 Hollow Concrete Masonry Units. ASTM C 90, Type I, grade N-I having an oven-dry weight of less than 105 pcf.

7.8 Horizontal Joint Reinforcement. Fabricated from steel wire using welded connections. Tack welding will not be permitted. The reinforcement shall conform to the following requirements.

7.8.1 Steel Wire. ASTM A 82. Wire sizes for the various types of joint reinforcement shown on the drawings shall not be less than those listed below.

<u>Type</u>	<u>Minimum Wire Size Longitudinal Wire</u>	<u>Minimum Wire Size Crosswires</u>
Standard Duty	9 gage	9 gage

7.8.2 Finish. Joint reinforcement for walls shall be formed from wire that has been zinc coated in accordance with ASTM A 116, Class 3.

7.8.3 Lengths. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Factory-formed pieces shall be provided at corners and intersections of walls and partitions.

7.8.4 Design. Design of joint reinforcement shall be as specified below for the various types of wall construction. The outermost longitudinal wires shall be spaced 2 inches plus or minus 1/8-inch less than the nominal thickness of the wall in which it is placed.

7.8.4.1 Single Wythe Hollow or Filled Cell Unit Construction. Ladder design having two or more smooth or deformed longitudinal wires. Joint reinforcement shall be of one design throughout all single wythe walls. The distance between contacts of crosswires with each longitudinal wire shall not exceed 6 inches for smooth longitudinal wires and 16 inches for deformed longitudinal wires.

7.9 Lime Paste. Lime paste shall be made with pulverized quicklime or hydrated lime. Hydrated lime processed by the steam method shall be allowed to soak not less than 24 hours. Quicklime and other hydrated lime shall be allowed to soak not less than 72 hours. In lieu of hydrated-lime paste for use in mortar, the hydrated lime may be added in the dry form.

7.9.1 Hydrated Lime. ASTM C 207, Type S.

7.9.2 Pulverized Quicklime. ASTM C 5, except 100 percent shall pass the No. 20 sieve and 90 percent shall pass the No. 50 sieve.

7.10 Reinforcing Bars. ASTM A 615, Grade 60.

7.11 Water. Water used in mortar and grout shall be taken from a supply distributed for domestic purposes and at the time of mixing shall be clean and free of acids, alkalies, or other organic materials.

## 8. MORTAR MIXES.

8.1 Proportions. Mortar shall be Type S in accordance with the proportion specifications of ASTM C 270 as modified below. Materials shall be Portland cement, hydrated lime or lime paste, aggregate, mortar coloring and water as specified herein. The mortar shall have a flow, after suction, of 70 percent or more when tested for water retention in accordance with ASTM C 91, except mortar shall be mixed to an initial flow of 125 to 135 percent.

## 9. GROUT MIXTURES.

9.1 Proportions. Grouts shall be mixed in laboratory established proportions to attain a compressive strength at 28 days of not less than 2,000 psi when tested in accordance with ASTM C 91 for fine aggregate and ASTM C 39 for grout containing coarse aggregate. Grout shall be used subject to the limitations of Table II.

9.1.1 Fine Grout. Fine grout shall consist of Portland cement, lime paste or hydrated lime, and fine aggregate mixed with sufficient water to obtain a pouring consistency without segregation of the constituents. Slump shall be between 9 and 11 inches.

9.1.2 Low-Lift Grout. Low-lift grout shall consist of Portland cement, lime paste or hydrated lime, fine aggregate and coarse aggregate mixed with sufficient water to obtain a pouring consistency without segregation of the constituents. Slump shall be between 9 and 11 inches. Maximum size of coarse aggregate for grout shall be in accordance with Table II.

9.1.3 High-Lift Grout. High-lift grout shall consist of Portland cement, grout admixture, fine aggregate, and pea gravel or coarse aggregate mixed with sufficient water to obtain a consistency suitable for pumping without segregation of the constituents. Slump shall be between 9 and 11 inches. The maximum size of coarse aggregate shall be in accordance with Table II.

9.2 Mixing. Batching and mixing of high-lift grout, including equipment used therein, shall conform to the applicable requirements of ASTM C 94.

10. PREPARATION OF CONCRETE SURFACES. Clean laitance, dust, dirt, oil, organic matter or other foreign materials from concrete surface upon which reinforced masonry is to be placed. Use sand blasting, if necessary, to remove laitance from pores and to expose the aggregate.

## 11. INSTALLATION.

11.1 Laying Masonry Units. Space back-up courses to level with facing courses where metal ties occur. Adjust each unit to its final position while mortar is still soft and plastic. Remove and relay in fresh mortar, any unit that is disturbed after mortar has stiffened. Keep chases, raked-out joints, and spaces to be grouted free from mortar and other debris. Units used in exposed masonry surfaces shall be free from chipped edges or other imperfections detracting from the appearance of the finished work.

11.1.1 Tolerances. Lay masonry plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Lay masonry within the following tolerances.

11.1.1.1 Variation from the plumb in the lines and surfaces of walls and arises.

- a. In adjacent masonry units - 1/8-inch.
- b. In 10 feet - 1/4-inch.

11.1.1.2 Variations from the plumb for external corners, expansion joints, and other conspicuous lines.

- a. 1/4-inch.

11.1.1.3 Variations from the level or grades indicated on the drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines.

- a. 1/4-inch.

11.1.1.4 Variations of the linear building lines from established position in plan and related portion of walls, and partitions.

a. 1/2-inch.

11.1.2 Cutting and Fitting. Wherever possible, use full units of the proper size in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units shall be wet cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Make openings carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Cut webs of hollow masonry units to the minimum required for proper installation. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, and cable trays unless steel sleeves are used.

11.1.3 Embedded Items. Fill spaces around metal door frames and other built-in items with mortar. Openings around flush-mount electrical outlet boxes in wet locations, including the flush joint above the box, shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashings, pipe sleeves and other items required to be built-in shall be built-in as the masonry work progresses. Embed anchors, ties and joint reinforcement fully in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout.

11.1.4 Unfinished Work. Step back unfinished work for joining with new work. Tothing may be resorted to only when specifically approved. Remove loose mortar and thoroughly clean the exposed joints before laying new work. After cleaning, dampen the surfaces of clay or shale brick as required to obtain a good bond with subsequent work.

11.1.5 Wetting Masonry Units. Do not wet concrete masonry units. Do not lay units having a film of water or frost on the surface.

11.1.6 Jointing. Tool joints when the mortar is thumbprint hard. Tool horizontal joints first. Brush joints to remove all loose and excess mortar. Mortar joints shall be finished as follows.

11.1.6.1 Flush Joints. Joints in concealed masonry surfaces and joints above electrical outlet boxes in wet areas shall be flush cut. Make flush cut joints by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight.

11.1.6.2 Tooled Joints. Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Tool joints with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint.

11.1.7 Joint Widths. Joint widths shall be approximately as follows.

11.1.7.1 Concrete Masonry Units. 3/8-inch wide.

11.2 Reinforced Hollow Unit Masonry. Reinforced hollow unit masonry shall consist of hollow concrete masonry units reinforced vertically and horizontally with steel bars located within cells or kerfs in the units and with cells containing reinforcing bars filled solidly with grout. Fill all cells solidly with grout below grade. Lay hollow masonry units so as to preserve the vertical continuity of cells filled with grout. The minimum clear horizontal dimensions of vertical cores shall be 2 inches by 3 inches. Units shall be masonry bonded at wall corners. Intersections shall be anchored by reinforcing bars or stirrups as indicated.

11.2.1 Cleanouts. Provide cleanout holes at the bottom of every pour in core containing vertical reinforcement when the height of the grout pour exceeds 48 inches. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Cleanouts shall be not less than 3- by 4-inch openings cut from one face shell. Manufacturers' standard cut-out units may be used at the Contractor's option. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed.

11.2.2 Bond Pattern. Lay hollow masonry units in running bond.

11.2.3 Mortar Joints. Fill bed joints with mortar for the full thickness of the face shell. Where only cells containing reinforcement are to be grouted, spread cross webs around such cells with mortar to prevent leakage of grout. Where all cells are to be grouted, spread cross webs with mortar at grout barriers only. Provide grout barriers not more than 25 feet apart as required to limit the horizontal flow of grout for each grout pour. Butter head joints for the full thickness of the face shell and shove the units into place. Avoid fins of mortar that protrude into cells to be grouted.

11.2.4 Bond Beams. Bond beams shall consist of bond beam units, reinforced as indicated but with not less than two No. 5 bars where not indicated and filled with grout. Use open bottom type bond beam units over cells to be filled. Place wire mesh or small mesh metal lath under open bond beam units if used over cells not to be filled. Structural bond beams at floor and roof levels shall be continuous at control joints. All other bond beams shall be discontinuous at control joints.

11.3 Placing Reinforcing Steel. Prior to placing grout, clean all reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond with the grout. Unless otherwise indicated, the details of reinforcement shall conform to ACI SP-66. Do not bend or straighten reinforcing in a manner injurious to the steel. Do not use bars with kinks or bends not shown on the drawings. Placement of reinforcement shall be inspected and approved prior to placing grout. Vertical bars shall be spliced only where indicated.

11.3.1 Positioning Bars. Position vertical bars accurately at the centerline of the wall. Maintain a minimum clearance between the bars and masonry units of 1/2-inch and between parallel bars of one diameter of the reinforcement. Hold vertical reinforcing in place using metal supports, centering clips, spacers, ties, or caging-devices located near the ends of each bar and at intermediate intervals of not more than 160 diameters of the reinforcement.

11.3.2 Splices. Locate splices only where shown on the drawings. Stagger splices in adjacent bars. Lap bars a minimum of 40 diameters of the reinforcement or 2 feet whichever is greater.

11.4 Placing Grout. Place grout using a hand bucket, concrete hopper, or grout pump. Place grout so as to completely fill the grout spaces without segregation of the aggregates. Where grouting is discontinued for more than 1 hour, stop the grout 1-1/2 inches below the top of a course to form a key at pour joints. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table II.

#### 11.4.1 Grouting Equipment.

11.4.1.1 Grout Pumps. Pumping through aluminum tubes will not be permitted. Operate pumps to produce a continuous stream of grout without air pockets. Upon completion of each day's pumping, eject grout from pipeline without contamination or segregation of the grout. Remove waste materials and debris from the equipment. Dispose of waste materials, debris, and all flushing water outside the masonry.

11.4.1.2 Vibrators. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Maintain at least one spare vibrator, or sufficient parts for repairing vibrators, at the site at all times. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

11.4.2 Low-Lift Method. Place grout as masonry is erected at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. If mortar has been allowed to set prior to grouting, remove all fins protruding more than 1/2-inch into the grout space. Place grout in final position within 2-1/2 hours after mixing when air temperature is 80 degrees F. or higher and 3-1/2 hours after mixing when the air temperature is less than 80 degrees F. Rod or puddle grout during placement using a 1 inch by 2 inch wood stick or a mechanical vibrator to insure complete filling of the grout space. Do not insert the vibrators into lower pours that are in a semi-solidified state.

11.4.3 High-Lift Method. Lay masonry to the top of a pour before placing grout. Do not pour grout in two-wythe solid unit masonry until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Do not pour grout in hollow unit masonry until mortar joints have set for at least 24 hours. Clean mortar droppings from the bottom of the grout space and from reinforcing steel. Remove mortar fins protruding more than 1/2-inch into the grout space by dislodging the projections with a rod or stick as the work progresses or by washing the grout space at least twice a day during erection using a high pressure stream of water. Place grout in final position within 1-1/2 hours after mixing when air temperature is 80 degrees F. or higher and 2-1/2 hours after mixing when the air temperature is less than 80 degrees F. Place grout in lifts not to exceed 4 feet in height, with a waiting period between lifts, dependent on weather and absorption rate of the masonry, in order to place the succeeding lift after the preceding lift becomes plastic but prior to initial set. The first lift shall be consolidated using mechanical vibrators. After the required waiting period, place the second lift and consolidate with the vibrator extending 12 to 18 inches into the previous lift. Do not insert vibrators into

lower pours that are in a semi-solidified state. Repeat the waiting, pouring, and consolidating process until the top of the grout pour is reached. Reconsolidate the top pour after the required waiting period. The high-lift grouting of any section of wall between lateral flow barriers shall be completed to the top of a pour in 1 working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned.

11.4.4 Blowouts. Brace walls against wind and other forces during construction. Allow sufficient time between lifts to preclude displacement of solid masonry units or cracking of face shells of hollow masonry units. If blowouts, misalignment, or cracking of face-shells should occur during construction, wall shall be torn down and re-built at no additional cost to the Government.

11.5 Pointing and Cleaning. After mortar joints have attained their initial set but prior to hardening, completely remove mortar and grout daubs or splashings from exposed masonry surfaces. Before completion of the work, rake out all defects in joints in exposed masonry surfaces, fill with mortar and tool to match existing joints. Immediately after grout work is completed remove scum and stains which have percolated through the masonry using a high pressure stream of water. Do not use metal tools or metal brushes for cleaning.

11.5.1 Concrete Masonry Units. Dry brush exposed concrete masonry unit surfaces at the end of work each day and after any required pointing. Use stiff-fiber bristled brushes only.

## 12. WATER RESISTANT SEALER.

12.1 General. A clear water resistant "sealer" shall be applied over all exposed interior masonry block surfaces except those to be painted at the rest rooms.

12.2 Materials. Water resistant sealer shall conform to Fed. Spec. SS-S-1996, Type II, Class B, Grade 2, with modifications as follows.

- a. Moisture vapor transmission rate shall be 0.1 to 0.25 maximum.

12.3 Certified Test Report. Test report showing that the proposed batch meets all the test requirements shall be submitted for approval. Test reports on previously tested material may be submitted provided it is certifying that the previously tested material is of the same type, quality, manufacturer, and make as that proposed for the project.

12.4 Surface Preparation. The surface shall be clean and free of dust, grease, oil, paint, and any other foreign matter. If acid is used for cleaning, it shall be washed off with clear water. Surface must be dry of moisture with a reading not in excess of 8 percent.

Table I. Reinforcement of Lintels.

Nominal Width (inches)	Nominal Height (inches)	Reinforcement
4 or 6	8	One No. 4 bar, top and bottom centered horizontally
8 or 10	8	Two No. 4 bars at bottom
8	16	One No. 4 bar at top centered horizontally
12	16	Two No. 4 bars each in top and bottom

Table II. Pour Height and Type of Grout for Various Grout Space Dimensions.

Minimum Horizontal Dimensions of Core (inches)	Grout Type (See paragraph Grout Mixtures)	Coarse Aggregate	Maximum Height of Grout Pour (inches)
2 by 3	Fine or mortar	None	8
2 by 4	Fine or mortar	None	16
2-1/2 by 4	Fine or low lift	ASTM C 404, Size 8	48
3 by 4	High lift	3/8-inch pea gravel	72 (1)
3-1/2 by 4	High lift	3/8-inch pea gravel	180 (1)
5 by 6	High lift	ASTM C 33, 3/4-inch Max.	180 (1)

(1) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between bond beams.

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SECTION 5A  
STRUCTURAL STEEL

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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 Specifications (Fed. Spec.).

TT-P-86G	Paint, Red-Lead-Base, Ready-Mixed
TT-P-615D & Am-3	Primer Coating. Basic Lead Silico Chromate, Ready Mixed
TT-P-645A	Primer, Paint, Zinc-Chromate, Alkyd Type

1.2 American Institute of Steel Construction (AISC) Publications.

Code of Standard Practice for Steel Buildings and Bridges (Sep 1, 1986, with Commentary)
Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Nov 1, 1978, with Commentary)
Specification for Structural Joints Using ASTM A 325 or A 490 Bolts (Aug 14, 1980)

1.3 American National Standards Institute (ANSI) Standards.

B18.22.1-1965 (R 1981)	Plain Washers
B46.1-1985	Surface Texture (Surface Roughness, Waviness and Lay)

1.4 American Society for Testing and Materials (ASTM) Publications.

A 6-85	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
A 36-87	Structural Steel
A 53-87a	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A 307-86a	Carbon Steel Externally Threaded Standard Fasteners
A 325-86a	High-Strength Bolts for Structural Steel Joints
A 490-85	Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
A 500-84	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 563-84	Carbon and Alloy Steel Nuts

1.5 American Welding Society (AWS) Publication.

D1.1-86	Structural Welding Code - Steel
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2. GENERAL REQUIREMENTS. The AISC Specification for the Design Fabrication and Erection of Structural Steel for Buildings shall govern the work. Welding shall be in accordance with SECTION: WELDING, STRUCTURAL. High-strength bolting shall be in accordance with the AISC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.

3. SUBMITTALS.

3.1 Certificates of Compliance. Certificates of compliance shall be submitted in accordance with the SPECIAL CLAUSES. Certified copies of mill test reports shall be furnished for structural steel. Certification that each welder is qualified in accordance with AWS Code D1.1 shall be provided.

3.2 Shop Drawings. Shop drawings shall be submitted for approval in accordance with the SPECIAL CLAUSES. Drawings shall include all shop and erection details. Members and connections for any portion of the structure not shown on the contract drawings shall be detailed by the fabricator and indicated on the shop drawings. All welds shall be indicated by standard welding symbols of the AWS.

3.3 Erection Plan. Prior to erection, the Contractor shall submit an erection plan of the structural steel framing. This erection plan shall conform to the requirements of the AISC Code of Standard Practice for Steel Buildings and Bridges. The erection plan shall describe all necessary temporary supports, including the sequence of installation and removal.

4. RESPONSIBILITY FOR ERRORS. The Contractor shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.

5. STORAGE. Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

6. MATERIALS shall conform to the following requirements.

6.1 Structural Steel.

6.1.1 Carbon Grade Steel. ASTM A 36.

6.2 Structural Tubing. ASTM A 500, Grade B.

6.3 Steel Pipe. ASTM A 53, Type E or S, Grade B.

6.4 Paint. Fed. Spec. TT-P-86, Type I or II; TT-P-615, Type I, II, or V; or TT-P-645.

6.5 Carbon Steel Bolts. ASTM A 307, Grade A.

6.6 Carbon Steel Nuts. ASTM A 563, Grade A, Hex Style.

6.7 Plain Washers, Other Than Those in Contact With High-Strength Bolts. ANSI B18.22.1, Type B.

7. FABRICATION shall be in accordance with the applicable provisions of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. Fabrication and assembly shall be done in the shop to the greatest extent possible. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ANSI B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6. Structural steelwork, except surfaces of steel to be encased in concrete, and surfaces to be field welded shall be prepared for painting in accordance with the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and primed with the specified paint.

8. ERECTION of structural steel shall be in accordance with the applicable provisions of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

8.1 Connections. Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work.

8.2 Base Plates and Bearing Plates. Column base plates for columns and bearing plates for beams and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be dry-packed solidly with bedding mortar.

8.3 Field Welded Connections. Field welded structural connections shall be completed before load is applied.

8.4 Field Priming. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

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SECTION 5B

WELDING, STRUCTURAL

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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 Institute of Steel Construction (AISC) Publication.

Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Nov 1, 1978, with Commentary)

1.2 American National Standards Institute (ANSI) Standard.

Z49.1-1973 Safety in Welding and Cutting

1.3 American Society for Nondestructive Testing (ASNT) Publication.

SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing (June 1980)

1.4 American Welding Society (AWS) Publications.

A2.4-79 Symbols for Welding and Nondestructive Testing

A3.0-80 Welding Terms and Definitions

D1.1-85 Structural Welding Code - Steel

2. GENERAL. This section covers structural welding in building construction. Welding shall be performed where indicated on the contract drawings, on approved shop drawings, and in other sections of the specifications. Unless otherwise indicated on the drawings or in other sections of the specifications, the design of welded connections shall conform to the applicable requirements of AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be in accordance with the requirements specified in this section except where additional requirements are shown on the drawings or are specified in other sections. Welding shall be by welders previously qualified by test for the work to be done.

2.1 Prequalified Procedures. All welding procedures shall be prequalified as covered by the applicable sections of AWS D1.1.

2.2 Quality Control. The Contractor shall be responsible for the quality of all welding and joint preparation. The Contractor shall perform visual inspection to determine conformance with paragraph: STANDARDS OF ACCEPTANCE, herein. Unacceptable welds shall be repaired by the Contractor at no additional expense to the Government. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1.

2.3 Definitions. Definitions of welding terms shall be in accordance with AWS A3.0.

2.4 Symbols. Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

2.5 Safety. Safety precautions during welding shall conform to ANSI Z49.1.

3. WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION. Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

3.1 Certificates. Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

4. WELDING EQUIPMENT AND MATERIALS. All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

5. WELDING OPERATIONS. Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. When AWS D1.1 and the AISC specification conflict, the requirements of AWS D1.1 shall govern.

6. INSPECTION AND TESTS. In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Government and the work may be performed by its own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with the paragraph: STANDARDS OF

ACCEPTANCE. The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

7. STANDARDS OF ACCEPTANCE. Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings.

8. CORRECTIONS AND REPAIRS. When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to insure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

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SECTION 5C

METAL ROOF DECK

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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 Iron and Steel Institute (AISI) Publication.

Specification for the Design of Cold-Formed Steel Structural Members  
(September 3, 1980, with Errata)

1.2 American Society for Testing and Materials (ASTM) Publications.

- |           |   |
|-----------|---|
| A 525-83  | Steel Sheet, Zinc-Coated (Galvanized)<br>by the Hot-Dip Process                           |
| C 423-84a | Sound Absorption and Sound Absorption<br>Coefficients by the Reverberation<br>Room Method |
| E 795-83  | Mounting Test Specimens During Sound<br>Absorption Tests                                  |

1.3 Steel Deck Institute (SDI) Publication.

Steel Deck Institute Design Manual for Composite Decks, Form Decks and  
Roof Decks, 1984

2. DESIGN. Section properties shall be determined in accordance with AISI Specification for the Design of Cold-Formed Steel Structural Members. Panels of maximum possible lengths shall be used to minimize end laps. The maximum allowable deflection of deck and maximum working stress shall conform to the SDI Design Manual for Composite Decks, Form Decks and Roof Decks. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems. There shall be no loads suspended from the deck.

3. SUBMITTALS.

3.1 Shop Drawings. Shop drawings shall be submitted for approval in accordance with the SPECIAL CLAUSES. Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and

supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of fastener connections; and the manufacturer's erection instructions.

3.2 Design Computations. Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with the SDI specifications shall be submitted with the shop drawings.

4. DELIVERY AND STORAGE. Materials shall be delivered to the site in a dry and undamaged condition and stored off the ground with one end elevated under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

#### 5. MATERIALS.

5.1 Deck Units. Deck units shall conform to the SDI Design Manual for Composite Decks, Form Decks and Roof Decks. Units shall be fabricated of 18 gage thick or thicker steel and shall be painted with one coat of manufacturer's standard paint. Finish painting shall be as specified in SECTION: PAINTING, GENERAL.

5.2 Touch-Up Paint. Touch-up paint for shop-painted units shall be of the same type used for the shop painting.

5.3 Accessories. The manufacturer's standard type accessories shall be furnished as necessary to complete the roof deck installation. Metal accessories shall be of the same material as the deck and have minimum gage as follows. Saddles, 18 gage; welding washers, 10 gage; cant strip 22 gage; other metal accessories, 20 gage; unless otherwise indicated.

5.3.1 Adjusting Plates. Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same gage and configuration as the deck units.

5.3.2 Closure Plates. Voids above interior walls shall be closed with 22 gage sheet metal where shown. Openings through roofs shall be closed with 22 gage sheet metal.

6. ERECTION of deck and accessories shall be in accordance with the SDI Design Manual for Composite Decks, Form Decks and Roof Decks and the approved shop drawings. Damaged deck and accessories and units with burned holes shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and alined at right angles to supports before being permanently secured in place. The deck shall not be used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load.

7. ATTACHMENT. The deck units shall be fastened with screws to supports as indicated on the shop drawings and in accordance with requirements of the SDI Design Manual for Composite Decks, Form Decks and Roof Decks. Holes and similar defects will not be acceptable.

8. REPAIR OF COATINGS. Welds shall be touched-up with an approved paint. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

9. OPENINGS THROUGH DECK. Holes and openings indicated shall be drilled or cut, reinforced and framed as shown. Other holes and openings required shall be drilled or cut, reinforced, and framed for rigidity and sufficient load-carrying capacity. Holes less than 6 inches across require no reinforcement. Openings 6 to 12 inches across shall be reinforced by 22-gage steel sheet at least 12 inches wider and longer than the opening and be fastened to the steel deck a maximum of 12 inches on center. Openings larger than 12 inches shall be reinforced by steel angles on opposite sides of the opening and at a right angle to the deck ribs. Both sides of the angles shall be fastened to each rib. Angles shall extend at least two ribs beyond each side of the opening.

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SECTION 5D

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 the basic designation only.

1.1 Federal Specifications (Fed. Spec.).

FF-S-325 (Int Am-3)	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
QQ-A-250/4	Aluminum Alloy 3003, Plate and Sheet
QQ-S-763D (Notice 1, Am-2)	Steel Bars, Wire, Shapes, and Forgings, Corrosion Resisting
RR-C-271B Am-1	Chains and Attachments, Welded and Weldless
RR-F-191H/GEN	Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General Specifications)
RR-G-1602B	Grating, Metal, Other Than Bar Type (Floor, Except for Naval Vessels)
TT-E-489G	Enamel, Alkyd, Gloss (For Exterior and Interior Surfaces)
VV-G-632A	Grease, Industrial, General Purpose

1.2 Military Specifications (Mil. Spec.).

Mil-F-3541A	Fittings, Lubrication
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1.3 The Aluminum Association (AA) Publications.

Designation System for Aluminum Finishes (7th Edition, Sep. 1980)

Standards for Anodized Architectural Aluminum (5th Edition, Oct. 1978)

1.4 American Society for Testing and Materials (ASTM) Publications.

A 36-84a	Structural Steel
A 53-86	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 123-84	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 320-84a	Alloy Steel Bolt Materials For Low-Temperature Service
A 386-78	Zinc Coating (Hot-Dip) on Assembled Steel Products
A 446-85	Steel Sheet, Zinc-Coated (Galvanized by the Hot-Dip Process), Structural (Physical) Quality
A 501-84	Specification For Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A 513-84a	Electrical-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
A 525-86	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
B 32-83	Solder Metal
B 209-84	Specification for Aluminum and Aluminum Alloy Sheet and Plate

1.5 American Welding Society (AWS) Publication.

D1.1-86	Structural Welding Code - Steel
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1.6 National Association of Architectural Metal Manufacturers (NAAMM) Manual.

Metal Bar Grating Manual (Oct. 1979; Suppl No. 1, Apr. 1980)

2. GENERAL REQUIREMENTS. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized, after fabrication. Galvanizing shall be in accordance with ASTM A 123, A 386, A 446, or A 525, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied.

Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

2.1 Dissimilar Materials. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

2.2 Shop Drawings. Shop drawings shall be submitted in accordance with SPECIAL CLAUSES. Shop drawings shall indicate material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Shop drawings for the following items shall be submitted:

- Aluminum Window Gratings
- Steel Window Frames
- Bent Sheet Metal Covers
- Picket Fence Panels (All Types) & Gates
- Pipe Posts (Fencing, Railings, and Entry Sign)

2.3 Welding shall conform to the provisions of AWS D1.1. Welders who have not been certified within 2 years of the date of commencement of work under this contract will not be allowed to perform the work.

2.4 Bolt holes shall be reamed or drilled normal to the member and shall be truly cylindrical throughout. Cutting bolt holes with a torch will not be permitted without the prior written approval of the Contracting Officer.

2.5 Samples. Samples shall be full size, shall be taken from manufacturer's stock, and shall be complete as required for installation in the structure. After approval, samples may be installed in the work, provided each sample is clearly identified and its location recorded. Samples of the following items shall be submitted for approval:

- Aluminum Gratings - (1) Full Size Flat Panel;
- (2) Full Size Radius Panel

2.6 Workmanship. Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevation and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

2.7 Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts, lag bolts, and screws for wood.

### 3. MATERIALS.

3.1 General. Materials indicated on the drawings or required in the work and not covered elsewhere by detailed requirements shall conform to the requirements of this section. In all cases where materials are not specifically covered in these specifications, the Contractor shall furnish approved highest grade commercial materials or products.

3.2 Steel pipe shall be zinc-coated (galvanized) steel pipe conforming to the requirements of ASTM A 53-86, Standard Weight, Schedule 40.

3.3 Steel Shapes and Plates.

3.3.1 Steel bars and plates shall conform to ASTM A 36. Galvanized coating, where required, shall conform to ASTM A 123.

3.3.2 Steel tubing shall conform to ASTM A 501, Grade A for posts, and ASTM A 513 for picket rails.

3.4 Concrete, mortar, grout, and formwork shall conform to the requirements of SECTION: REINFORCED MASONRY.

3.5 Formwork shall conform to SECTION: CONCRETE.

3.6 Chain shall be galvanized and shall conform to the requirements of Fed. Spec. RR-C-271, Type I, Grade C, Class 4. The chain shall be attached with a galvanized connecting link and shall accommodate a 5/16-inch diameter padlock shackle.

3.7 Bolts and anchor bolts shall conform to Fed. Spec. 00-S-763, Class 304, Condition A, or the applicable requirements of ASTM A 320, Grade B8. Nuts shall be galvanized.

3.8 Expansion bolts shall conform to Fed. Spec. FF-S-325.

3.9 Grease fittings shall conform to Mil. Spec. MIL-F-3541.

3.10 Aluminum Gratings shall be made of one inch by 3/16-inch aluminum cross bars swaged to aluminum cross bars.

3.11 Steel Window Frames shall be 16 GA galvanized hollow metal type with screw attached metal stops.

3.12 Bent sheet metal column covers shall be made of 12 GA galvanized sheet metal.

3.13 Aluminum Finishes. Unless otherwise specified, aluminum items shall have black anodized finish conforming to AA Standards for Anodized Architectural Aluminum. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior location in AA Designation System for Aluminum Finishes. Items to be anodized shall receive a polished-satin-finish pretreatment and a clear-lacquer overcoating.

#### 4. FABRICATION.

4.1 Picket Fence and Gate Panels. Pickets shall be steel tubing with caps as shown on project plans welded at the top of the pickets. Fence and gate panels shall be fabricated in the shop. Pickets, rails, and brackets shall be finished to provide smooth, straight edges free of burrs. All surfaces of the fence panels and brackets shall be cleaned in the shop to remove all rust, scale, dirt, and other foreign matter. "Tight" mill scale that cannot be lifted by applying a sharp knife to any edge will be permitted. The cleaning shall be accomplished by scraping, wire brushing, and wiping or other approved methods. The cleaning and painting operations shall be carried out in such a manner that the time between cleaning and the application of paint will not exceed 24 hours. Any damage of the picket fence panels during transportation and/or installation will be cause for rejection of the fence panels. Any chipping of original color during transportation and/or installation shall be repainted with original color.

4.2 Concrete Fence Posts. Steel base plates for posts need not be galvanized. Any cracking of the fence posts during installation of fence panel brackets will be cause for rejection of the post, and the damaged post shall be replaced at no additional cost to the Government (the Contractor will not be permitted to repair damaged posts).

4.3 Gratings For Drainage Structures. Gratings shall be fabricated from steel bars. Steel grating and mounting bars shall be galvanized after fabrication.

4.4 Aluminum Gratings. Bearing Bar shall be spaced 1 3/16-inches on-center and cross bars shall be spaced 4-inches on-center gratings shall be fabricated in straight and curved sections as shown.

4.5 Steel Window Frames. Shall be attached to metal stops. Anchor to head plate with wires at 6-foot on-center both sides.

4.6 Bent Sheet Metal Column Covers shall be bent to shapes indicated on the plans. All connections shall be welded. All exposed welds shall be ground smooth. All sharp edges shall be eased.

4.7 Shop Painting. Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

#### 5. INSTALLATION.

5.1 Aluminum Gratings shall be mounted in hollow metal window frames and in hollow metal doors.

5.2 Steel Window Frames shall be anchored to top of masonry walls with "T" anchors embedded in grouted bond beam.

5.3 Fence posts, both concrete and steel, shall be installed plumb. Fence posts shall be installed to provide a straight and even alignment. Fence panels shall be installed level and in a straight alignment from one side of the post to the other. All bolts and nuts shall be tight. Expansion anchors shall be snug and shall not permit movement when tested by hand. Surfaces of galvanized metals that are abraded, cut, or welded during installation shall be neatly covered with grade 50B solder conforming to ASTM B 32.

5.4 Excavation for concrete-embedded items shall be of the dimensions indicated on the drawings. Holes shall be cleared of loose materials prior to placement of concrete.

5.5 After fence panels are fastened to the posts, the heads of anchoring bolts and any painted areas that are damaged during installation shall be painted with paint conforming the requirements for shop painting above. Paint shall be applied with a brush (spray methods shall not be used). Any such paint that gets on other than the surfaces specified to be painted shall be removed by the Contractor at no additional cost to the Government.

5.6 The Contractor shall use non-shrink grout conforming to the requirements of SECTION: REINFORCED MASONRY to fill the voids under and above the base plates for fence posts.

5.7 The Contractor shall grease all gates thoroughly with grease conforming to Fed. Spec. VV-G-632 immediately after installation of each gate. The gates shall be installed in such a fashion that they work freely. The Contractor shall examine the operation of all gates not sooner than 30 days after installation for ease of operation. Any gates that cannot be operated by one person will be repaired (including any required structural modifications) by the Contractor at no additional cost to the Government.

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SECTION 5E

SIGNS

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 designated only.

1.1 Federal Specifications (Fed. Spec.).

QQ-A-250/4E Aluminum Alloy 2024, Plate and Sheet

1.2 American National Standards Institute (ANSI) Publications.

D6.1-1978 Uniform Traffic Control Devices for Streets and Highways

1.3 American Society for Testing and Materials (ASTM) Publications.

A 36-84a Structural Steel

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

A 123-84 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A 525-83 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Method

1.4 American Welding Society (AWS) Publication.

D1.1-85 Structural Welding Code - Steel

2. GENERAL. Signs shall be constructed in accordance with these specifications, applicable portions of other sections as specified hereinafter, and the drawings. The Contractor shall provide shop drawings and other data to indicate art work and manufacturing and installation details of the signs as indicated on the drawings. Welding shall be in accordance with AWS D1.1.

3. SUBMITTALS. The Contractor shall submit shop drawings and product data as specified in the SPECIAL CLAUSES. The shop drawings and product data shall indicate component details, materials, finishes, connections and joining methods, painting, lettering, logos, and the relationship to adjoining work.

4. MATERIALS shall conform to the respective specifications, shop drawings and requirements specified below:

4.1 Aluminum Plate. Fed. Spec. QQ-A-250/4, temper 9, standard mill finish. The approximate weight shall be 86 pounds.

4.2 Steel Rails and Pipe Sleeves. ASTM A 53, Type E or S, Grade B.

- 4.3 Exposed Aggregate Concrete shall conform to SECTION: CONCRETE.
- 4.4 Forms for concrete construction shall conform to SECTION: CONCRETE.
- 4.5 Paint shall conform to SECTION: PAINTING, GENERAL.
- 4.6 Steel Posts shall conform to ASTM A 53-86, seamless. Posts shall be galvanized after fabrication. Concrete shall conform to SECTION: CONCRETE.
- 4.7 Steel Support. ASTM A 36.
- 4.8 Warning Sign Face shall be fabricted in one piece from 16 gauge, galvanized steel sheets conforming to ASTM A 525, coating G90. The sign shall be reflectorized with yellow standard reflective sheeting. Factory-fabricated signs shall confrom to the requirements of ANSI D6.1.
- 4.9 Fastening Hardware. Theft-Proof and carriage bolts, metal washers and nuts shall be commercial quality steel, hot-dip galvanized after fabrication. Fiber washers shall be of commercial quality.
- 4.10 Logos for the Army Corps of Engineers and City of Glendale shall be adhesive vinyl and shall be of vandal resistant materials.

## 5. INSTALLATION.

- 5.1 Entry Sign. Installation of steel rails shall be in pipe sleeves embedded in concrete as indicated, joints welded and ground smooth. Rails shall be provided with steel sign supports of the size and locations indicated. Supports shall be accurately located and welded to the rails. Welds shall be ground smooth and the entire assembly shall be galvanized after fabrication. Aluminum plate shall be carefully aligned and secured to the supports with theft-proof bolts.
- 5.2 Warning Sign. Post shall be set plumb in excavated hole of the size indicated. Hole shall be cleared of loose material. Concrete shall be thoroughly compacted so as to be free of voids and finished in a dome. Sign faces shall be installed plumb with fastening hardware as indicated. Any chipping or bending of sign panels shall be considered as sufficient cause to require replacement of panels at the Contractor's expense.

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SECTION 5F

PIPE RAILINGS

1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) Standards 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.

ASTM A 53-86

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

ASTM A 386-78

Zinc-Coating (Hot-Dip) on Assembled  
Steel

2. SHOP DRAWINGS. Shop drawings, along with catalog cuts, templates, and erection and installation details, as appropriate, for all miscellaneous items of work shall be submitted for approval in accordance with the "General Requirements". Submittals shall be complete in detail; shall indicate type, style, and dimensions; and shall show construction details, anchorage, and installation.

3. STRUCTURAL REQUIREMENTS. Railing assembly, wall rails, and attachments are to resist lateral force of 30 pounds per linear foot without damage or permanent set.

4. MATERIALS.

4.1 Rails and Posts. 1-1/2 inch diameter X .145 inches-thick steel pipe conforming to ASTM A 53-86; welded jointing.

4.2 Fittings. Elbows, tee-shapes, wall brackets, escutcheons; cast steel.

4.3 Mounting. Brackets and flanges, with steel inserts for casting in concrete.

4.4 Splice Connectors. Steel concealed spigots.

4.5 Galvanizing shall conform to SECTION: MISCELLANEOUS METALS.

4.6 Prime and Finish shall conform to SECTION: PAINTING, GENERAL.

5. FABRICATION.

5.1 Verify dimensions on site prior to shop fabrication.

5.2 Fit and shop assemble sections in largest practical sizes, for delivery to site and installation.

5.3 Supply components required for secure anchorage of handrails and railings.

5.4 Grind exposed welds smooth and flush with adjacent surfaces.

5.5 Make exposed joint butt tight, flush, and hairline.

5.6 Accurately form components required for anchorage of railings to each other and to building structure.

6. PREPARATION.

6.1 Supply items to be cast into concrete with setting templates and erection drawings to appropriate sections.

7. INSTALLATION.

7.1 Install in accordance with shop drawings.

7.2 Erect work square and level, free from distortion or defects detrimental to appearance or performance.

7.3 Anchor handrailings to structure.

7.4 Weld field connections and grind smooth to complete assembly. Touch-up welds with primer.

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SECTION 7A

CAULKING AND SEALANTS

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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 Specifications (Fed. Spec.).

TT-S-00227E  
& Am-3

Sealing Compound. Elastomeric Type,  
Multi-Component (for Caulking,  
Sealing, and Glazing in Buildings  
and Other Structures)

1.2 American Society for Testing and Materials (ASTM) Publication.

D 217-82

Cone Penetration of Lubricating Grease

2. GENERAL REQUIREMENTS. Caulking and sealants shall be provided in joints as indicated or specified. The joint design, shape, and spacing shall be as indicated. Mixing shall be in accordance with instructions provided by the manufacturer of the sealants.

3. SUBMITTALS.

3.1 Certificates of Compliance. Certificates of compliance stating that the caulking and sealants conform to the specified requirements shall be submitted in accordance with the SPECIAL CLAUSES. Certificates shall include laboratory test reports showing that the caulking and sealants have been tested within the last 12 months.

3.2 Descriptive Data. Manufacturer's descriptive data including backstop material, primer and sealer shall be submitted for approval. Descriptive data for elastomeric sealants shall include shelf life, curing time, and mixing instructions for two component sealants.

3.3 Samples. Five cartridges or 2 quarts of each caulking and sealant specified herein shall be submitted for approval. The sample containers shall include the same information on the label as specified herein for containers delivered to the job.

4. ENVIRONMENTAL REQUIREMENTS. The ambient temperature shall be within the limits of 40 to 90 degrees F. when the caulking and sealants are applied.

5. DELIVERY AND STORAGE. Materials shall be delivered to the job in the manufacturer's original unopened containers. The containers shall include the following information on the label: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time when applicable at the standard conditions for laboratory tests. Caulking compound or components outdated as indicated by shelf life shall not be used. Materials shall be carefully handled and stored to prevent inclusion of foreign materials or exposure to temperatures exceeding 90 degrees F. Sealant tape shall be handled and stored in a manner that will not deform the tape.

6. MATERIALS shall conform to the respective specifications and other requirements specified. Each container brought to the jobsite with a different sealant formulation shall be marked for the intended use. For each intended use, the color shall be one of the manufacturer's standard colors as selected by the Contracting Officer.

6.1 No. 2 Sealant. No. 2 sealant shall be a two-component, elastomeric-type compound conforming to Fed. Spec. TT-S-227, Type II, Class A. The compound shall be supplied in pre-measured kit form for on-the-job mixing.

7. PRIMER for No. 2 sealant shall be as recommended by the sealant manufacturer. Primer shall have been tested for durability with the sealant to be used and on samples of the surfaces to be sealed.

8. BACKSTOP MATERIAL shall be resilient urethane or polyvinyl-chloride foam, closed-cell polyethylene foam, closed-cell sponge of vinyl or rubber, polychloroprene tubes or beads, polyisobutylene extrusions, oilless dry jute, or rope yarn. Backstop material shall be nonabsorbent, nonstaining, and compatible with the sealant used. Tube or rod stock shall be rolled into the joint cavity. Preformed support strips for ceramic and quarry tile control-joint and expansion-joint work shall be polyisobutylene or polychloroprene rubber.

9. BOND-PREVENTIVE MATERIALS shall be pressure-sensitive adhesive polyethylene tape, aluminum foil or wax paper. At the option of the Contractor, backstop material with bond breaking characteristics may be installed in lieu of bond-preventive materials specified.

10. SURFACE PREPARATION.

10.1 General. The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from all joint surfaces to be sealed. Oil and grease shall be removed with solvent and surfaces shall be wiped with clean cloths.

10.2 Concrete and Masonry Surfaces. Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

10.3 Steel Surfaces. Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

10.4 Aluminum Surfaces. Aluminum surfaces of windows and door frames in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be nonstaining.

11. SEALANT USES. The sealant to be used in the various joints indicated shall be as follows.

Joint Symbol	Sealant No.
** _____ **	** _____ **

## 12. APPLICATION.

12.1 Paper Masking Tape. Paper masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or compound smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

12.2 Bond-Preventive Materials. Bond-preventive materials for No. 2 sealant shall be installed on the bottom of the joint cavity and other surfaces indicated to prevent the sealant from adhering to the surfaces covered by the bond-preventive materials. The materials shall be carefully applied to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond-preventive materials.

12.3 Backstops. The back or bottom of joints constructed deeper than indicated shall be packed tightly with backstop material to provide a joint of the depth indicated. Where necessary to provide a backstop for caulking compound, the joint shall be packed tightly with rope yarn.

12.4 Primer. Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not receive primer.

12.5 No. 2. Compound shall be gun-applied with a nozzle of proper size to fit the width of joint indicated and shall be forced into grooves with sufficient pressure to expel air and fill the groove solidly. Sealant shall be uniformly smooth and free of wrinkles. Joints shall be tooled slightly concave after sealant is installed. When tooling white or light-color sealant, dry or water-wet tool shall be used.

13. CLEANING. The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the caulking and sealing application as work progresses.

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SECTION 8A

STEEL DOORS AND FRAMES

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 Door and Hardware Institute (DHI) Publication.

The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames, and Builders Hardware, (1977)

1.2 Steel Door Institute (SDI) Specification.

100-83	Standard Steel Doors and Frames
106-66	Recommended Door Type Nomenclature
107-84	Hardware on Steel Doors

2. SUBMITTALS.

2.1 Shop Drawings. Shop drawings shall be submitted for approval in accordance with the SPECIAL CLAUSES. Shop drawings shall use standard door type nomenclature in accordance with SDI 106 and shall indicate the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of struts and anchors for frames, and thicknesses of metal.

3. DELIVERY AND STORAGE. To provide protection during shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or provided with temporary steel spreaders at the bottom of each frame; and knockdown type frames shall be securely strapped in bundles. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting good air circulation. Doors and assembled frames shall be stored in an upright position. Whenever damage becomes evident, abraded, scarred, or rusty areas shall be cleaned and touched up with the paint used for the shop painting.

4. GENERAL REQUIREMENTS FOR DOORS AND FRAMES. Doors and frames shall be factory fabricated conforming to SDI 100, the grades shown on the door and door frame schedules, and the additional requirements specified herein. Exterior doors and frames shall be galvanized.

4.1 Doors and Frames. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under SECTION: HARDWARE; BUILDERS' (GENERAL PURPOSE). Rubber silencers shall be installed on door frames. Where frames are installed in masonry walls, plaster guards shall be provided on door frames at hinges and strikes.

4.2 Closed Top Edges. Exterior doors shall have top edges closed flush and sealed against water penetration.

4.3 Grating. Where indicated, doors shall be provided with full aluminum grating as specified in SECTION: MISCELLANEOUS METAL. Grating shall be inserted into door and shall be nonremovable from the outside of Exterior Doors. Grating doors shall be SDI 100, Grade III, Model 5, fitted with grading.

5. INSTALLATION shall conform to DHI publication The Installation of Commercial Steel Doors and Steel Frames, and Builders Hardware. Steel doors and frames shall reinforced, drilled, and tapped to receive mortised hinges, locks, latches, flush bolts, and closers as required. Preparation for hardware shall be in accordance with SDI 107.

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SECTION 8B

HARDWARE; BUILDERS' (GENERAL PURPOSE)

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| 6. Finishes                         | 13. Application        |
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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 National Standards Institute (ANSI) Standards.

A115.1-1982	Standard Steel Door and Steel Frame Preparation For Mortise Locks for 1-3/8" and 1-3/4" Doors
A156.1-1981	Butts and Hinges
A156.5-1984	Auxiliary Locks & Associated Products
A156.7-1981	Template Hinge Dimensions
A156.13-1980	Mortise Locks & Latches
A156.16-1981	Auxiliary Hardware
A156.18-1984	Materials and Finishes

1.2 Builders Hardware Manufacturers Association (BHMA) Standards.

Directory of Certified Locks & Latches (Effective through June 1986)

1.3 Door and Hardware Institute (DHI) Publication.

Installation of Commercial Steel Doors and Steel Frames (1977)

Keying - Procedures, Systems and Nomenclature (Jan 1978)

Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames (1976)

Recommended Locations for Builders' Hardware for Standard Steel Doors and Frames (1975)

2. GENERAL. Hardware shall conform to the requirements specified herein and to the listing: HARDWARE SETS at the end of this section. Hardware set numbers correspond to the set numbers shown on the drawings.

3. TEMPLATES. Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to ANSI A156.7.

4. SUBMITTALS.

4.1 Certificates of Compliance. Certificates of compliance attesting that hardware items conform to the ANSI or BHMA standards under which the items are specified shall be submitted in accordance with the SPECIAL CLAUSES. A statement that the proposed hardware items appear in the current applicable BHMA directories of certified products may be submitted in lieu of certificates.

4.2 Hardware Schedule. Hardware schedule listing all items to be furnished shall be submitted for approval. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding ANSI or BHMA standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

4.3 Keying Schedule. Keying schedule shall be developed in accordance with DHI Keying - Procedures, Systems and Nomenclature and shall be submitted for approval.

5. PACKAGING, MARKING, AND LABELING. Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule.

6. FINISHES. Unless otherwise specified, finishes shall conform to those identified in ANSI A156.18.

6.1 Hinges. Hinges shall have the following finishes:

a. Inswinging exterior door hinges: 626.

6.2 Lock and Door Trim. Lock and door trim shall have the following finishes:

a. All door lock and trim: 626.

6.3 Miscellaneous Hardware. Miscellaneous hardware shall have the following finish: 626.

7. FASTENINGS of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel.

8. KEYING. Locks shall be keyed in sets as scheduled. Keys shall be supplied as follows:

Locks:	2 keys each lock.
Master keyed sets:	2 keys each set.
Grand master keys:	2 total.

The keys shall be furnished to the Contracting Officer arranged in sets as scheduled.

9. DEADLOCKS. Deadbolts shall be the product of a single manufacturer.

9.1 Mortise Deadlocks. Mortise deadlock shall be series 1000 and shall conform to ANSI A156.13. Strikes shall conform to ANSI A115.1. Mortise-type deadlocks and latchsets for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

9.2 Lock Cylinders. Lock cylinders shall comply with ANSI A156.5. Lock cylinder shall have not less than six pins. Provide a grand master keying system. Disassembly of knob or lockset shall not be required to remove core from lockset.

10. AUXILIARY HARDWARE, consisting of door stops shall conform to ANSI A156.16.

11. HINGES shall conform to ANSI A156.1. Hinges used on metal doors and frames shall also conform to ANSI A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

11.1 Hinges shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

11.2 Contractor's Option. Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges.

12. MISCELLANEOUS.

12.1 Metal Thresholds. Thresholds shall be extruded aluminum of the type as indicated and shall provide proper clearance.

12.2 Special Tools. Special tools shall be provided, such as spanner and socket wrenches and dogging keys, required to adjust hardware items.

13. APPLICATION. Hardware shall be located in accordance with DHI Recommended Locations for Builders' Hardware for Standard Steel Doors and Frames and DHI Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI The Installation of Commercial Steel Doors and Steel Frames.

13.1 Thresholds. Exterior thresholds shall be installed in a bed of sealant with stainless steel screws and expansion shields. Minimum screw size shall be #10, length dependent on job conditions.

HARDWARE SETS

HW-1	1-1/2 pair	Hinges, A8111
	1 each	Deadlock, F-16-Grade 1
	1 each	Threshold, 4 x 1/2, J603
	1 each	Stop

HW-2	1-1/2 pair	Hinges, A8111
	1 each	Deadlock, F-17-Grade 1
	1 each	Threshold, 4 x 1/2, J603
	1 each	Stop

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SECTION 9A

PAINTING, GENERAL

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1. APPLICABLE PUBLICATONS. 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.).

A-A 1500A	Sealer Surfaces (Latex Block Filler)
TT-C-535B & Am-2	Coating, Epoxy, Two Component, for Interior Use on Metal, Wood, Wallboard, Painted Surfaces, Concrete and Masonry
TT-E-489G	Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)
TT-E-505A & Am-3	Enamel, Odorless, Alkyd, Interior, High Gloss, White and Light Tints
TT-E-506K & Am-1	Enamel, Alkyd, Gloss, Tints and White (for Interior Use)
TT-E-508C & Am-2	Enamel, Interior, Semigloss, Tints and White
TT-E-509B & Am-2	Enamel, Odorless, Alkyd, Interior, Semigloss, White and Tints
TT-E-543A & Am-1	Enamel, Interior, Undercoat, Tints and White
TT-E-545B & Am-1	Enamel, Odorless, Alkyd, Interior- Undercoat, Flat, Tints and White
TT-F-1098D	Filler, Block, Solvent-Thinned, for Porous Surfaces (Concrete Block, Cinder Block, Stucco, Etc.)

TT-P-19D	Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
TT-P-29J & Am-1	Paint, Latex Base, Interior, Flat, White and Tints
TT-P-30E & Am-1	Paint, Alkyd, Odorless, Interior, Flat, White and Tints
TT-P-38D & Am-1	Paint, Aluminum, Ready-Mixed
TT-P-91D & Am-2	Paint, Rubber-Base, for Interior Use (Concrete and Masonry Floors)
TT-P-102E & Int Am-1	Paint, Oil, Alkyd Modified, Exterior, White and Tints
TT-P-650C & Am-1	Primer Coating, Latex Base, Interior, White (for Gypsum Wallboard)
TT-P-1511B	Paint, Latex (Gloss and Semigloss, Tints and White) (For Interior Use)
TT-S-179B & Am-1	Sealer Surface: Pigmented Oil, for Plaster and Wallboard
TT-V-51F	Varnish: Asphalt

1.2 Federal Standard (Fed. Std.).

No. 595a & Change Notices 2, 3, 4, 5, 7 & Errata, 8	Colors
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1.3 Military Specifications (Mil. Spec.).

MIL-P-26915B	Primer Coating, Zinc Dust Pigmented, for Steel Surfaces
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1.4 American Society for Testing and Materials (ASTM) Publication.

C 150-85a	Portland Cement
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1.5 Steel Structures Painting Council (SSPC) Specifications.

SSPC-SP 1-82	Solvent Cleaning
SSPC-SP 3-82	Power Tool Cleaning
SSPC-SP 7-85	Brush-Off Blast Cleaning

SSPC-Paint 5-82	Zinc Dust, Zinc Oxide, and Phenolic Varnish Paint
SSPC-Paint 11-82	Red Iron Oxide, Zinc Chromate, Raw Linseed Oil and Alkyd Paint
SSPC-Paint 21-82	White or Colored Silicone Alkyd Paint
SSPC-Paint 25-82	Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC-Paint 27-82	Basic Zinc Chromate - Vinyl Butyral Wash Primer

1.6 American National Standards Institute (ANSI) Standard.

A13.1-1981	Scheme for the Identification of Piping Systems
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2. DEFINITION. The term "paint" as used herein includes emulsions, enamels, paints, stains, varnishes, sealers, cement-emulsion filler, and other coatings, whether used as prime, intermediate, or finish coat.

3. PACKAGING, LABELING, AND STORAGE. Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints shall be stored on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for testing. Emulsion paints shall be stored to prevent freezing.

4. SUBMITTALS.

4.1 Certificates of Compliance. Except for lead-based metal primers for use in concealed spaces, a certificate of compliance shall be furnished in accordance with the SPECIAL CLAUSES attesting that all paints proposed for use in structures which are readily accessible to children contain not more than 0.06 percent lead, as defined in paragraph: HAZARDOUS MATERIALS RESTRICTIONS.

4.2 Manufacturer's Instructions. Detailed mixing, thinning and application instructions, minimum and maximum application temperature, and curing and drying times between coats shall be furnished for epoxy and catalized polyurethane. The instructions shall also include surface preparation requirements and the number and types of coats required for each surface. Detailed application instructions shall be furnished.

4.3 Sample Panels. A complete liquid glaze coating system shall be applied to a panel of the same material as that on which the coating will be applied in the work and shall be submitted for approval for each color specified. The approved sample panels will be used for quality control in applying the glaze coating system.

4.4 Samples. While the material is at the site or source of supply, and at a time agreeable to the Contractor and the Contracting Officer, a 1-quart sample of each color and batch, except for quantities of 50 gallons or less, shall be taken by random selection from the sealed containers by the Contractor in the presence of a representative of the Contracting Officer. The contents of the sampled containers shall be thoroughly mixed to ensure that the sample is representative. Samples shall be identified by designated name, specification number, manufacturer name and address, batch number, project contract number, intended use, and quantity involved.

4.5 Proprietary Paint Materials. The Contractor shall submit for approval the names, quantity represented, and intended use for the proprietary brands of materials proposed to be substituted for the specified materials when the required quantity of a particular color is 50 gallons or less.

4.6 Test Report. The Contractor shall furnish a statement as to the quantity represented and the intended use, plus the following test report for batches in excess of 50 gallons.

a. A test report showing that the proposed batch to be used meets all specification requirements, or;

b. A test report showing that a previous batch of the same formulation as the batch to be used met all specification requirements, plus, on the proposed batch to be used, a report of test results for properties of weight per gallon, viscosity, fineness of grind, drying time, color, and gloss.

5. COLORS AND TINTS. Colors shall conform to Fed. Std. 595A (Change Notice 7) and shall be as listed on the drawings and as selected. The color of the undercoats shall vary slightly from the color of the next coat.

6. QUALITY ASSURANCE PROVISIONS. When samples are tested, approval of materials will be based on tests of the samples; otherwise, materials will be approved based on test reports furnished with them. If materials are approved based on test reports furnished, samples will be retained by the Government for testing should the materials appear defective during or after application. In addition to any other remedies under the contract the cost of retesting defective materials will be at the Contractor's expense.

7. ENVIRONMENTAL CONDITIONS. Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F. when applying coatings other than water-thinned, epoxy, and liquid glaze coatings. Water-thinned coatings will be applied only when ambient temperature is between 50 and 90 degrees F. Epoxy, and liquid glaze coatings will be applied only within the minimum and maximum temperatures recommended by the coating manufacturer. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch. In no case shall paint be applied to surfaces which have visible frost or ice.

8. MATERIALS shall conform to the requirements listed herein and in the PAINTING SCHEDULE, except when the required amount of a material of a particular color is 50 gallons or less, in which case an approved first-line proprietary paint material with similar intended usage and color to that specified may be used.

8.1 Cement-Emulsion Fill Coat. Fill coat shall be an acrylic-based fill coat and shall consist of the following:

- a. White Portland Cement. 16.5 pounds.
- b. Aggregate. 33.5 pounds.
- c. Mixing Liquid. 0.75 gallon.
- d. Potable Water. 1.0 gallon maximum.
- e. Exterior Emulsion Paint. 1.0 gallon.

8.1.1 The white Portland cement shall conform to ASTM C 150, Type I. The aggregate shall be washed silica sand of the following gradation.

<u>U.S. Sieve Size</u>	<u>Percent Sand (by Weight) Passing Individual Sieve</u>
20	100
30	95-100
50	30-65
100	0-10
200	0-1

8.1.2 The mixing liquid shall be the same resin emulsion as used in formulating the exterior emulsion paint. The acrylic mixing liquid shall contain 46 to 47 percent solids. The mixing liquid shall be factory-prepared. The exterior emulsion paint shall be exterior acrylic emulsion paint conforming to Fed. Spec. TT-P-19.

8.2 PAINT COLOR. Paint color shall conform to the following.

8.2.1 Metal Pipe Railing and Metal Fence Pickets (other than at irrigation stations) shall be painted blue between the following stations: Sta. 203±00 to Sta. 220±00, Sta. 260±00 to Sta. 311±00. - Fed. Spec. No. 15102.

8.2.2 Metal Pipe Railing and Metal Fence Pickets at irrigation stations - Flat black.

8.2.3 Restroom Interior (including the floor) - Fed. Spec. No. 26492 (Warm Gray).

8.2.3.1 Restroom Exterior door and grating shall be painted blue - Fed. Spec. No. 15102.

8.2.4 All Stucco - Fed. Spec. No. 35630 (Warm Blue-Gray).

8.2.5 Spaceframe - Fed. Spec. No. 11105 (Burgundy).

9. HAZARDOUS MATERIALS RESTRICTIONS. Paints and painting practices shall comply with all applicable state and local laws enacted to insure compliance with Federal Clean Air Standards.

9.1 Lead. Except for lead-based metal primers for use in concealed spaces, paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

9.2 Mercury. Mercurial fungicides shall not be used in exterior oil paints.

## 10. SURFACE PREPARATION.

10.1 General Requirements. Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Exposed ferrous metals, including nails on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas. Surfaces to be painted shall be clean before application of paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Items removed prior to painting shall be replaced when painting is completed.

10.2 Concrete, Stucco and Masonry Surfaces. Surfaces shall be allowed to dry at least 30 days before painting. Glaze, efflorescence, laitance, dirt, grease, oil, asphalt, surface deposits of free iron and other foreign matter shall be removed prior to painting.

10.2.1 Concrete-masonry-unit surfaces to be coated with cement-emulsion filler. Immediately before coating, surfaces to be painted shall be dampened uniformly and thoroughly, with no free surface water visible, by several applications of potable water with a fog spray, allowing time between the sprayings for water to be absorbed.

10.2.2 Concrete surfaces to receive epoxy coatings. Surfaces shall be acid-etched or mechanically abraded as specified by the coating manufacturer, rinsed with water and the concrete allowed to dry. The dry concrete surface shall then be treated with the manufacturer's recommended conditioner prior to application of the first coat.

10.3 Ferrous Surfaces. Ferrous surfaces that have not been shop-coated shall be solvent-cleaned. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with power tools according to SSPC-SP3 or by sandblasting according to SSPC-SP7. After cleaning, one coat of ferrous-metal primer shall be applied to all ferrous surfaces to receive paint other than asphalt varnish and vinyl paint. The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

10.4 Aluminum, Galvanized and Nonferrous Surfaces. Aluminum, galvanized and nonferrous surfaces to be painted shall be acid etched and solvent cleaned in accordance with SSPC-SP1. Surface then to be treated with an aldehyde corrosion-resistant material. Followed by a vinyl-type wash coat meeting the requirements of SSPC-Paint-27-82.

## 11. MIXING AND THINNING.

11.1 Packaged Paint Preparations. Packaged paint other than cement-emulsion filler may be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon when necessary to suit conditions of surface, temperature, weather, and application methods. The use of thinner shall not relieve the Contractor from obtaining complete hiding. Paints of different manufacturers shall not be mixed.

11.2 Cement-Emulsion Fill Coat. Cement and aggregate shall be dry-mixed so that uniform distribution and intermixing are obtained. Mixing liquid and one-half of the total amount of water shall be premixed and added gradually to the white Portland cement and aggregate with constant stirring until a thick, smooth material is obtained. Emulsion paint shall then be added to the mixture and stirred until uniformity is obtained. The blend shall have a thick, creamy consistency. The remainder of the water shall be added if necessary to obtain a material with adequate application properties. Blending resin emulsion or emulsion paint with any other component shall be done with caution; too rapid an agitation will cause air entrapment and foaming.

11.3 Epoxy and Catalized Polyurethane. Two-component systems shall be mixed in strict accordance with manufacturer's instructions. Any thinning of the first coat to insure proper penetration and sealing will be as recommended by the manufacturer for each type of substrate.

11.4 Vinyl-Type Wash Coat. SSPC-Paint 27 wash coat shall be mixed by adding one volume of acid component to four volumes of resin component as follows. First, the resin component will be mixed to break up settled pigment; the acid component will then be added slowly to the resin component with constant stirring. The wash coat shall be used within 8 hours. The material may be reduced with normal butyl alcohol, 99 percent isopropyl alcohol, or denatured ethanol if thinning is required to maintain a wet spray.

## 12. APPLICATION.

12.1 General Requirements. Paint may be applied by brush, roller, or spray. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

12.1.1 Adequate ventilation shall be provided during paint application. Respirators shall be worn by all persons engaged in spray painting. Adjacent areas shall be protected by approved precautionary measures.

12.1.2 The first coat shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. The first coat on both faces of doors shall be applied at essentially the same time.

12.1.3 Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch. Floor sealer shall be given additional touch-up coats as necessary to eliminate dull spots. Excess sealer shall be wiped off after each application.

12.2 Time Between Surface Preparation and Painting. Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface.

12.3 Coating Progress. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion.

12.4 Epoxy and Catalized Polyurethane. Manufacturer's instructions for application, surface preparation, curing and drying time between coats will be followed. Second coats will be applied at a maximum spreading rate of 450 square feet per gallon.

#### 12.5 Masonry Surfaces.

12.5.1 General. Masonry surfaces may be coated by brush, roller, or spray, except when using filler coats. When using fillers, surface voids shall be filled; however, surface irregularities need not be completely filled. The filler shall not be applied over caulking compound.

12.5.2 Cement-Emulsion Filler. Cement-emulsion filler shall be scrubbed into the surface vigorously with a stiff-bristled brush having tampico or palmyra bristles not longer than 2-1/2 inches. At least 24 hours shall elapse before applying exterior emulsion paint over cement-emulsion filler. When the ambient temperature is over 85 degrees F., cement-emulsion filler surfaces shall be dampened lightly with a fog spray of potable water immediately prior to application of the subsequent paint coat.

12.6 Metal Surfaces. First coats other than vinyl paints or vinyl-type wash coats shall be applied by brush. The three-coat paint systems specified for exterior and interior ferrous surfaces shall be applied so that their dry-film thickness at any point shall be not less than 4.0 mils, with the primer having a minimum dry-film thickness of 1.5 mils. Vinyl paint systems for exterior ferrous surfaces subject to severe atmospheric exposures shall be applied in accordance with applicable provisions of SSPC-PA 1. The dry-film thickness of the four-coat system at any point shall be not less than 5.0 mils, with the primer having a minimum dry-film thickness of 1.3 mils.

12.7 Vinyl-Type Wash Coat. Vinyl-type wash coat shall be applied by spray at a spreading rate of 250 to 300 square feet per gallon to give a dry-film thickness of 0.3 mil to 0.5 mil. A wet spray shall be maintained at all times. Surfaces shall be permitted to dry for 1 hour and shall be coated as soon as practical within 24 hours and prior to any deterioration or accumulation of dust or dirt.

13. SURFACES TO BE PAINTED. Surfaces listed in the PAINTING SCHEDULE, other than those listed in paragraph: SURFACES FOR WHICH PAINTING IS PROHIBITED, will receive the surface preparation, paints, and number of coats prescribed in the schedule.

14. SURFACES FOR WHICH PAINTING IS PROHIBITED. The following listed items shall not be painted: Stainless steel and chrome plated accessories, shade fabric and ties.

15. CLEANING. Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

16. PAINTING SCHEDULE. The PAINTING SCHEDULE prescribes the surfaces to be painted, and the number and types of coats of paint.

16.1 Contractor's Options. The PAINTING SCHEDULE provides for Contractor's options as specified by the word "or" between each system.

16.2 Shop-Painted Items. Surfaces of items finish-painted by the manufacturer, or specified to be finish-painted under other sections of the specifications, are exempted from the requirements for surface preparation and painting. Shop-primed items shall receive surface preparation and finish painting as required by this section.

16.3 Surface Preparation. The phrase "as previously specified" as used to define surface preparation in the PAINTING SCHEDULE refers to paragraph: SURFACE PREPARATION of this section of the specification.

17. PAINTING SCHEDULE.

<u>Surface</u>	<u>Surface Preparation</u>	<u>Primer</u>	<u>Finish</u>
Exterior stucco.	Remove foreign matter, efflorescence, and loose particles and roughen glazed surfaces.	TT-P-19	TT-P-19
Exterior ferrous surfaces, exposed, unless otherwise specified.	As previously specified.	Exterior oil paint. TT-P-38. TT-E-489, Class A.	Exterior oil paint. TT-P-38. TT-E-489, Class A.
		or	
		SSPC-Paint 21 Type I.	SSPC-Paint 21 Type I.

<u>Surface</u>	<u>Surface Preparation</u>	<u>Primer</u>	<u>Finish</u>
Exterior galvanized surfaces.	As previously specified.	MIL-P-26915, Type I, Class A, or SSPC-PAINT 27-82	Exterior oil paint.
Exposed interior oil-based caulking compound.	As specified in SECTION: CAULKING AND SEALANTS.	TT-P-38.	Same as adjacent areas.
Exterior steel space frame.	As previously specified.	As previously specified.	CATALIZED POLYURETHANE
Pipe railing.	As previously specified.	As previously specified.	CATALIZED POLYURETHANE
Exterior alum. and alum-alloy surfaces.	As previously specified	As previously specified	CATALIZED POLYURETHANE
Interior concrete floors.	As previously specified except allow to age 90 days minimum.	TT-P-91	TT-P-91
Interior concrete unless otherwise specified.	As previously specified.	TT-S-179. TT-P-650 TT-S-179 or TT-P-650 TT-P-650	TT-P-30 TT-P-29 TT-E-508 TT-E-509 TT-P-1511, Type I
Interior concrete masonry units, plaster and gypsum board for heavy traffic areas and areas requiring high degree of sanitation in spaces as follows:	As previously specified. Fill surface of concrete masonry units with TT-F-1098 or A-A-1500 filler.	TT-C-535, Type II.	TT-C-535, Type II.
Interior exposed ferrous surfaces, unless otherwise specified, and interior underside of zinc-coated and shop-primed steel roof decking where exposed in areas having painted walls.	As previously specified.	TT-P-30. TT-E-543. or TT-E-545. TT-E-543. or TT-E-545. TT-P-38.	TT-P-30 TT-E-508 TT-E-509. TT-E-505. TT-E-506. TT-P-38.

<u>Surface</u>	<u>Surface Preparation</u>	<u>Primer</u>	<u>Finish</u>
Interior unpainted ferrous surfaces in concealed damp areas or in exposed areas having unpainted adjacent surfaces.	Solvent cleaning and wire brushing; no pretreatment.	TT-V-51.	
Ferrous surfaces of mechanical and electrical equipment that has been factory-primed.	Solvent-clean as specified.	TT-E-489, Class A.	TT-E-489, Class A.
		or	
		SSPC-Paint 21, Type I.	SSPC-Paint 21, Type I.
Convactor enclosures, electrical conduit runs, metallic tubing, uninsulated ducts and pipes, pipe hangers, louvers, grilles, and air outlets in areas having painted adjacent surfaces.	As previously specified.	Where painted adjacent surfaces have gloss finish: TT-E-543	TT-E-506
		or	
		TT-E-545	TT-E-505
		Where painted adjacent surfaces have semigloss finish: TT-E-543.	TT-E-508.
		or	
		TT-E-545	TT-E-509
		Where painted adjacent surfaces have flat finish: TT-P-30	TT-P-30

\* \* \* \* \*

SECTION 9B

STUCCO

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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.).

UU-B-790a & Int Am-1	Building Paper, Vegetable Fiber. (Kraft, Waterproofed, Water Repellent and Fire Resistant)
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1.2 American Society for Testing Materials (ASTM) Publications.

C 150-85a	Portland Cement
C 206-84	Finishing Hydrated Lime
C 897-83	Aggregate for Job-Mixed Portland Cement-Based Plasters
C 926-81	Application of Portland Cement - Based Plaster

2. SUBMITTALS.

2.1 Samples. The following samples shall be submitted for approval before proceeding with the stucco work. One panel of stucco 12 inches square showing finish texture and color; one 12-inch length of each accessory proposed for use.

2.2 Shop Drawings. Shop drawings shall be submitted for approval in accordance with the SPECIAL CLAUSES. Shop drawings shall show details of construction and shall include detailed description of base and finish coat proportions of stucco mixes proposed to be used, including identification of thickness of coats and locations where each mix and coating thickness will be used.

3. DELIVERY AND STORAGE. Packaged materials shall be delivered to the site in the original packages and containers with labels intact and seals unbroken. Cementitious materials shall be kept dry until ready to be used and stored off the ground, under cover and away from damp surfaces. Aggregate shall be covered to prevent the absorption or loss of moisture.

4. ENVIRONMENTAL CONDITIONS. Stucco shall not be applied when the ambient temperature is 40 degrees F. or lower, or when a drop in temperature below 40 degrees F. is expected within 48 hours after application.
5. PORTLAND CEMENT shall conform to ASTM C 150 gray Portland Cement Type II.
6. COLORED FINISH is to conform to requirements of SECTION: PAINTING, GENERAL.
7. LIME shall conform to ASTM C 206, Type S.
8. ACCESSORIES shall be roll-formed galvanized steel, zinc alloy or rigid vinyl except that cornerite and striplath shall be formed from steel sheets with manufacturer's standard protective coating.
9. WATER shall be clean, fresh, potable, and free from amounts of oils, acids, alkalis and organic matter that would be injurious to the stucco.
10. CONTROL JOINTS shall be located as indicated on the drawings. Prefabricated control joint members shall be installed prior to the application of the stucco. Control joints shall be cleared of all stucco within the control area after stucco application and prior to final stucco set.
11. PREPARATION OF SURFACES for application of stucco to solid bases such as stone, masonry or concrete shall conform to the applicable requirements of ASTM C 926.
12. PROPORTIONS AND MIXING for job-mixed base coat and finish coat shall conform to the applicable requirements of ASTM C 926. Proportions for mill-mixed finish coat shall conform to the proportions for job-mixed finish coat in accordance with ASTM C 926 and mixing of mill-mixed finish coat shall be in accordance with the manufacturer's directions.
13. STUCCO APPLICATION. Stucco shall be applied in two coats to a thickness of not less than 1/2 inch as measured from the back plane of the masonry, to the finished stucco surface, including moderate texture variations. Stucco application shall conform to the applicable requirements of ASTM C 926 and the following.
  - 13.1 Workmanship. Items or features of the work in connection with or adjoining the stucco shall be in place, plumb, straight, and true prior to beginning the stucco work. Masonry surfaces to receive stucco shall be evenly dampened immediately prior to application of stucco. Each stucco coat shall be applied continuously in one general direction, without allowing mortar to dry at edges. Where it is impossible to work the full dimension of a wall surface in a continuous operation, jointing shall be made at a break, opening, or other natural division of the surface. Edges to be joined shall be dampened slightly to produce a smooth confluence. Exterior corners of stucco shall be slightly rounded.
  - 13.2 Brown Coat. The masonry shall be dampened evenly to obtain uniform suction before the brown coat is applied. There shall be no visible water on the surface when the brown coat is applied. The brown coat shall be applied to the masonry with sufficient pressure to force the stucco into the masonry and shall be brought to a plumb, true, even plane with rod or straightedge. When set sufficiently, the brown coat shall be uniformly floated with a dry float to promote densification of

the coat and to provide a surface receptive to bonding of the finish coat. Brown coat shall be fog cured for a minimum of 48 hours or until such earlier time the finish coat is applied.

13.3 Finish Coat. Surfaces of the brown coat shall be dampened not more than 1 hour before the finish coat is to be applied to a uniform wetness with no free-standing water on the surface. The finish coat shall have a smooth trowel finish and shall conform to the approved sample. The finish coat shall be fog cured for a minimum of 48 hours. Care shall be taken to prevent staining.

13.4 Surface Tolerance. When a 10-foot straightedge is placed at any location on the finished surface of the stucco excluding rough-textured finish, the surface shall not vary more than 1/8 inch from the straightedge.

14. CURING AND PROTECTION. Fog curing shall be accomplished by applying a fine mist of water to the stucco. Care shall be exercised during fog curing to avoid erosion damage to the stucco surfaces. A solid stream of water shall not be used. Frequency of fogging shall be not less than twice daily. When directed, the Contractor shall protect the stucco from the direct rays of the sun during severe drying conditions using canvas, cloth or other approved sheet material.

15. PATCHING AND POINTING. Loose, cracked, damaged, or defective work shall be replaced or patched as directed. Patching shall match existing work in texture and color and shall be finished flush.

\* \* \* \* \*

SECTION 10A

TOILET PARTITIONS

1. APPLICABLE PUBLICATION. The Federal Specification (Fed. Spec.) listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

RR-P-1352B

Partitions, Toilet, Complete

2. DESCRIPTION. Toilet partitions, including toilet enclosures, shall conform to the layouts shown. Materials shall be stainless steel.

3. SHOP DRAWINGS shall be submitted for approval in accordance with the SPECIAL CLAUSES. Shop drawings shall show plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

4. TOILET ENCLOSURES shall conform to Fed. Spec. RR-P-1352, Type I, Style A with handrail. Width of toilet enclosures shall be as shown. Finish surface of panels shall be stainless steel. Panel indicated to receive toilet paper holders or grab bars as specified in SECTION: TOILET ACCESSORIES shall be reinforced for the reception of the items required.

5. INSTALLATION. Toilet partitions shall be installed straight and plumb with all horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by expansion bolts in masonry. Drilling for installation of anchors shall be at locations that will be concealed in the finished work.

6. ADJUSTMENT AND CLEANING. Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Toilet partitions shall be cleaned and protected from damage until acceptance.

\* \* \* \* \*

SECTION 10B

TOILET ACCESSORIES

1. APPLICABLE PUBLICATION. The Federal Specifications (Fed. Spec.) listed below, forms a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

WW-P-541/8B

Plumbing Fixtures (Accessories, Land Use) (Detail Specification)

2. GENERAL REQUIREMENTS. Toilet accessories as specified herein shall be provided where indicated in accordance with schedule on drawings. Each accessory item shall be complete with the necessary mounting plates, anchors, and fasteners. Concealed mounting plates shall be of sturdy construction with corrosion resistant surface.

3. SAMPLES AND DESCRIPTIVE DATA. One sample of each accessory proposed for use shall be submitted for approval. Samples shall be accompanied by descriptive data indicating materials of construction, fasteners proposed for use for each type of wall construction, and mounting instructions. Approved samples may be incorporated into the finished work provided they are identified and their locations noted.

4. ANCHORS AND FASTENERS shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be well suited for use with the supporting construction. Exposed fasteners shall be of tamper-proof design.

5. FINISHES on metal shall be provided as follows.

Metal

Finish

Stainless Steel

No. 4 General-Purpose Polished

6. ACCESSORY ITEMS shall conform to the respective specifications and other requirements specified below.

6.1 Grab Bar (GB). Grab bar shall conform to Fed. Spec. WW-P-541, Type IV, Class 2, 1-1/4 inches OD. Grab bar shall be of the form and length indicated. Flange shall have screw mounting holes concealed on the lip of the flange. Grab bar shall have a smooth finish. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation.

6.2 Mirror, Metal (MM). Metal mirror shall be stainless steel or chromium plated steel, mirror quality, 0.037-inch minimum thickness, edges turned back 1/4 inch and recess fitted with fiber board backing, mounted with concealed theftproof fastening. Design with a tilt type frame for the handicapped. Size shall be in accordance with toilet accessory schedule on drawings.

6.3 Sanitary Napkin and Tampon Disposer (SND). Sanitary napkin and tampon disposer shall conform to Fed. Spec. WW-P-541, Type II, Mounting P, stainless steel. Reusable liner of the type standard with the manufacturer shall be provided.

6.4 Recessed Soap Dispenser (SD). Recessed soap dispenser shall be liquid type consisting of a vertical stainless steel tank with holding capacity of 40 fluid ounces.

6.5 Toilet Tissue Dispenser (TTD). Toilet tissue dispenser shall conform to Fed. Spec. WW-P-541, Type I, Class 1, Style A, stainless steel.

6.6 RECESSED ELECTRIC HAND DRYER.

6.6.1 Hand dryer assembly shall be installed where indicated on drawings.

6.6.2 Hand dryer shall be electrically operated, recessed type.

6.6.3 Cover shall be acid resistant, porcelain enameled, one-piece gray cast iron and shall be equipped with insulated, chrome-plated push button, and 360° rotating nozzle. Air inlet opening shall be equipped with tamper-proof grille.

6.6.4 Recess mounting box shall be 16 ga. steel with baked enamel, rust-proof finish.

6.6.5 Fan motor shall be 1/10 H.P., 7500 RPM rated; with resilient mounting and sealed lubricated ball bearings. Motor shall be protected by 2 AMP fuse.

6.6.6 Fan shall be double inlet, enclosed centrifugal type, mounted on motor shaft. Air flow shall be directed through heating element at 5500 f.p.m.

6.6.7 Heating element shall be rated at 2140 Watts and shall be protected by integral circuit breaker.

6.6.8 Timing mechanism shall be designed to operate for approximately 30 seconds after actuating push button.

6.6.9 Hand dryer shall operate on 115 Volts, 60 HZ.

7. INSTALLATION. Toilet accessories shall be securely fastened to the supporting construction in accordance with the approved submittals. Accessories shall be protected from damage from the time of installation until acceptance.

8. SCHEDULE. See drawings for toilet accessory schedule showing number and location of specified toilet room accessories.

\* \* \* \* \*



## 5. VOLLEYBALL NET POSTS, BASKETBALL GOALS, AND BACKBOARDS.

5.1 Installation. Volleyball net posts, basketball goals, and backboards shall be installed in the locations shown on the project plans and in accordance with manufacturers' requirements.

5.2 Volleyball net posts shall be constructed of 3-inch O.D. SCH. 40 galvanized steel pipe. Basketball goals shall be constructed of 4-1/2-inch O.D. SCH. 40 galvanized steel pipe with a 4-foot offset. Backboards shall be 1/4-inch galvanized steel plate painted white. Volleyball net posts, basketball goals and backboards shall be manufactured by a company regularly engaged in the manufacturing of such products.

## 6. TOT LOT EQUIPMENT.

6.1 Installation. The play equipment shall be installed in the location shown on the drawings and in accordance with the manufacturer's requirements.

6.2 The play equipment shall be a standard product of a manufacturer regularly engaged in the manufacturing of such equipment.

6.2.1 All upright posts and side rails on play structure shall be 5-inch O.D. steel tubing with 11 gage wall thickness. Safety rails, ladder rungs, turning bars, and deck supports shall be 1-5/16-inch standard pipe, 50-1/2 inches long. All metal components, after fabrication, shall be freed of excess weld and shall be cleaned in a three bath system which includes a zinc chromate wash before finish is applied. The colored finish shall be blue and electrostatically coated with polyester powder coating to be cured at temperatures in excess of 500°F. All open pipe ends shall be protected with spherical plastic caps.

6.2.2 Decks for the play structure are to be constructed of coated steel platforms. Wood decking is not acceptable. Each deck shall measure approximately 53 inches x 42 inches. Platforms shall be constructed of 9 gauge expanded steel welded to an outer frame of 4 inches x 1/8-inch steel. All platform surfaces shall be fused to a heavy coating of Plastisol PVC or equivalent. All platform coating shall be brown in color. Platform support rods shall be of 1-7/8-inch O.D., 2.28 pounds per foot steel pipe minimum.

6.2.3 Plastic parts (tunnels, panels, tunnel elbows, pipe and post caps) shall be made from polyethelene which will be ultra-violet light stabilized with a high density cross linked structure.

6.2.4 Aluminum attachment fittings (half clamps, swing hangers, and tee clamps) shall be cast in aluminum and swing hangers shall have oil impregnated bronze bushings fitted; they shall be powder coated in matching colors.

6.2.5 Chain shall be assembled with necessary hardware at the factory and coated with orange colored vinyl as one complete unit. Balance cables shall be made of coated chain.

6.2.6 Slide bedways shall be die formed from 18 gage stainless steel and edges covered with 3/4 inch diameter stainless steel tubing. Five inch O.D. x 11 gage steel tubing shall be used as side rails.

6.2.7 All connecting hardware shall be vandal resistant with minimal protrusions. All hardware necessary for assembly shall be provided and zinc plated or stainless steel fasteners shall be incorporated.

7. BIKE RACK. Bike racks shall be anchored in a concrete base as shown on the drawings. Bike racks shall be the size and finish indicated in the drawings. The bike rack shall be constructed of ASTM A 53 schedule 40 steel pipe (2.375 and outer diameter x .154" wall) and hot-dipped galvanized after fabrication.

8. BENCHES (OTHER THAN PICNIC BENCHES).

8.1 Benches shall be a pre-assembled, welded product of a manufacturer regularly engaged in the production of metal benches. Bench frames shall be 1-1/2-inch diameter x 3/32-inch wall steel tubing and 1/16-inch-thick perforated steel. All steel shall be electrostatically galvanized after assembly. The metal finish shall be a tan colored thermosetting polyester color coating. The color shall be a standard color and be consistent among all benches.

8.2 Benches shall be anchored to a concrete base as shown on the plans.

9. TREE GRATE.

9.1 Installation. Tree grates shall be a two piece unit suitable for expanding tree opening. Radial bar sunburst pattern, with cast iron angle frame 180° square. Secure angle frame and grate in place as recommended by manufacturer.

10. KIOSK.

10.1 Kiosk Construction shall conform to the requirements of the following SECTIONS: CONCRETE; MISCELLANEOUS METALS; WELDING, STRUCTURAL; and PAINTING, GENERAL.

10.2 Pipe shall be 6 inches in diameter with 11 gage wall thickness. Fabricate as shown on plans. All metal components, after fabrication, shall be free of excess weld and shall be cleaned before finish is applied. The color finish shall match the space frame of the rest rooms. Anchor pipe frame in concrete footing level and plumb, fasten redwood slats as per plan.

11. REMOVABLE BOLLARDS.

11.1 Prime and paint bollards to match railing color. Reflective paint shall be applied as per M.A.G. SECTION: 530 PAINT.

11.2 Installation. Bollards shall be 4 inch schedule 40 galvanized steel with 5 inch diameter pipe sleeve. Secure pipe sleeve in concrete footing as shown on drawings. Provide Contracting Officer with (1) padlock per bollard with (2) keys fitting all locks.

12. BARBECUE GRILL.

12.1 General. C.M.U. barbecue grill shall conform to requirements of SECTIONS: REINFORCED MASONRY; CONCRETE; MISCELLANEOUS METAL; and PAINTING, GENERAL. Fabricate as shown on plans.

12.2 Grill shall be 7 gage, 1/2-inch diameter steel grate surrounded by 5/8-inch diameter steel frame. Grill shall be custom manufactured.

### 13. PICNIC RAMADA.

13.1 General. Picnic Ramada shall conform to the requirements of SECTIONS: CONCRETE; MISCELLANEOUS METAL; WELDING, STRUCTURAL; and PAINTING, GENERAL.

13.2 Fabrication of the Picnic Ramadas shall include manufacturing and installing the Ramada as shown on the drawings.

13.3 Crest work square and level, free from distortion or defects detrimental to appearance or performance. Weld connections shall be ground smooth and cleaned before finish is applied.

13.4 Prime and paint all metal finishes as specified. Pipe, posts, and beams shall be blue conforming to Fed. Std. #15102. Roof deck shall be burgundy conforming to Fed. Std. #11105.

### 14. TUBULAR STEEL FENCE (PICKET FENCE) AND GATES.

14.1 General. Tubular steel fence and gates shall conform to requirements of SECTIONS: REINFORCED CONCRETE MASONRY, MISCELLANEOUS METAL, and WELDING. Fabricate tubular steel fence and gates as shown on drawings and connect to concrete masonry walls and galvanized steel posts as shown on drawings. Paint color as per SECTION: PAINTING, GENERAL; and as shown on project plans.

15. REINFORCED CONCRETE POSTS shall conform to requirements in SECTION: CONCRETE. Posts shall be set plumb and in alignment. Posts shall be set in concrete bases of dimensions indicated. If bedrock is encountered before reaching the required depth, the excavation shall be continued to the depth indicated or 18 inches into the bedrock, whichever is less. Post holes shall be cleaned of loose material. Waste material shall be spread where directed by the Contracting Officer. Concrete posts shall incorporate color admixture, conforming to SECTION: CONCRETE SIDEWALKS, CURBS AND GUTTERS, AND SLOPE PROTECTION.

16. RAISED FIRE PITS shall conform to the requirements of the SECTION: CONCRETE.

17. HANDICAP FITNESS AREA. The handicap fitness area shall consist of the following:

- a. Handicap equipment for nine (9) stations.
- b. Signage adapting course for handicap use.
- c. Rubber mat surface (pavers).

17.1 Handicap equipment shall be as designated on the project plans, as manufactured by Landscape Structures, Inc., or equal. Equipment shall be installed as per manufacturer's recommendations.

17.2 Information signage shall be provided for each equipment station. Signage shall be adopted for handicap use and shall provide exercise instructions applicable to each station. Signage shall be manufactured by the same

manufacturer as the exercise equipment unless otherwise approved by the Contracting Officer. Install as per manufacturer's recommendations.

17.3 Rubber Mat Surface (pavers) shall be "Elastocrete" pavers as manufactured by Romaflex, Inc. 1815 Drew Road, Mississauga, Ontario, Canada L5S 1J5, telephone (416) 677-1999, or equal. Pavers shall be Interlock Pavers (8" X 6-1/2" X 1-3/4") and shall be installed as per manufacturer's recommendations and as per the project plans.

17.3.1 Filter fabric shall be 4.0 oz./m<sup>2</sup> material manufactured specifically as filter material.

17.3.2 Sand bedding material shall have a particle size of 0 to 3mm with at least 30 percent at 3mm. Material shall conform to other requirements of SECTION: AGGREGATE BASE COURSE.

17.3.3 Aggregate Base Course shall be 1/2-inch to 3/4-inch in size and conform to other requirements of SECTION: AGGREGATE BASE COURSE.

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SECTION 13A

SPACE FRAMES

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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 Institute of Steel Construction (AISC) Publications.

Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings (Nov. 1, 1978, with commentary)

Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts (Aug. 14, 1980)

1.2 American Society for Testing and Materials (ASTM) Standards.

A 6-84c	General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
A 36-84a	Structural Steel
A 53-84a	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 307-84	Carbon Steel Externally Threaded Standard Fasteners
A 325-84	High-Strength Bolts for Structural Steel Joints
A 490-84	Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
A 500-84	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 563-84	Carbon and Alloy Steel Nuts

1.3 American Welding Society (AWS) Publication.

D1.1-85

Structural Welding Code - Steel

1.4 International Conference of Building Officials Publication.

Uniform Building Code (U.B.C.), 1985

2. GENERAL REQUIREMENTS. The AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings shall govern the work. Welding shall be in accordance with AWS Code D1.1. High-strength bolting shall be in accordance with the AISC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts. Unless specified otherwise this work includes, but is not limited to the following:

Space Frame  
Anchors, Connectors, and Accessories  
Shade Fabric Connectors, and Accessories

3. SUBMITTALS.

3.1 Certificates of Compliance. Certificates of compliance shall be submitted in accordance with the SPECIAL CLAUSES. Certified copies of mill test reports shall be furnished for structural steel. Certification that each welder is qualified in accordance with AWS Code D1.1 shall be provided.

3.2 Shop Drawings. Shop Drawings shall be submitted for approval in accordance with the SPECIAL CLAUSES. Drawings shall include all shop and erection details. Members and connections for any portion of the structure not shown on the contract drawings shall be detailed by the fabricator and indicated on the shop drawings. All welds shall be indicated by standard welding symbols of the AWS. Show the relationship of the space frame to other construction including anchorages in other work.

4. RESPONSIBILITY FOR ERRORS. The Contractor shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.

5. STORAGE. Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

6. SAMPLES AND DESCRIPTIVE DATA. One sample of each component proposed for use shall be submitted for approval. Samples shall be accompanied by descriptive data indicating materials of construction and fasteners proposed for use.

7. DESIGN CRITERIA.

7.1 Design of the space frame shall be based on the following industrial standards:

- a. American Institute of Steel Construction (AISC) (Code of Standard Practice for Steel Building and Bridges)
- b. American Welding Society (AWS)
- c. Uniform Building Code (UBC)

7.2 Steel space frame component design.

7.3 The design of members and connections of all portions of the space frame shall be completed by and be the sole responsibility of the manufacturer.

7.4 Design Loads.

7.4.1 Dead Load (D.L) = 15 PSF (Assumed Space Frame Weight) + 5 PSF (Superimposed).

7.4.2 Live Load (L.L.) = 20 PSF.

7.4.3 Horizontal Wind Load (H.W.L.) = 25 PSF (Assumed to act on a solid horizontal projected surface area).

7.4.4 Wind Uplift Load (W.U.L.) = 30 PSF (Assumed to act on a solid vertical projected surface area).

7.4.5 Temperature Range (T) = 80 Degrees F.

7.4.6 Seismic Zone (E.L.) = 2.

7.4.7 Secondary Loads. As shown on drawings.

7.5 Load Case Combination Analysis. The above loads are to be combined in the following manner to provide working stresses for the component design.

7.5.1 D.L.

7.5.2 D.L. + L.L.

7.5.3 D.L. + (H.W.L. + W.U.L.) or E.L.

7.5.4 D.L. + T.

7.5.5 D.L. + L.L. + (H.W.L. + W.U.L.) or E.L.

7.5.6 D.L. + L.L. + T.

7.5.7 D.L. + (H.W.L. + W.U.L.) or E.L. + T.

7.5.8 D.L. + L.L. + (H.W.L. + W.U.L.) or E.L. + T.

7.6 The above combinations are to be analyzed using the following probability factors:

7.6.1 100 percent combinations 1 through 4.

7.6.2 75 percent combinations 5 through 7.

7.6.3 66 percent combination 8.

7.7 Application of Design Loads. If design loads are applied to the space-frame chord members they shall be designed to carry the combined axial and bending stresses. No loads are to be applied to any of the web members.

7.8 Foundations shall be designed for the allowable soil parameters given for Class 4 materials as indicated in Table 29-B of the U.B.C., a minimum bottom of footing depth of 3-feet below finish grade, a factor of safety of 1.5 for overturning, and a concrete compressive strength of 3000 psi. Foundation design shall be performed by a Registered Professional Engineer and shall be submitted at the same time and in conjunction with the other structural calculations and the shop drawings as one package.

8. STRUCTURAL CALCULATIONS. Prior to fabrication of the space frame, submit design calculations which are to include column loads and size, member stresses support reactions, deflections, selected member tables, and foundation sizes.

8.1 Existing test report will not be acceptable in lieu of structural calculations.

8.2 The structural calculations are to be performed under the direction of a professional engineer, and are to bear his or her seal.

8.3 Structural calculations are to be submitted at the same time and in conjunction with the shop drawings as one package.

9. STEEL SPACE FRAME SYSTEM.

9.1 Product. Square Chord, Round Web Type.

9.2 Module. Eight-foot square and four-foot square as shown.

10. MAJOR COMPONENTS.

10.1 Chords. The chord members shall consist of square structural steel tubing (ASTM A 500, Grade B), with centrally welded (E-70 TX) truncated steel plates (ASTM A 36, Class A) at each end.

10.2 Webs. The web members shall consist of round structural steel tubing (ASTM A 53, Type E or S, Grade B) with a quarter node (ASTM A 36) welded at each end.

10.3 Bolts. The bolts shall be selected in accordance with the design loads given in the structural analysis. The bolts shall meet the requirements of ASTM A 307, A 325 or A 490.

10.4 Columns. The columns shall consist of steel pipe (ASTM A 53, Types E or S, Grade B) with a minimum diameter as shown on the plans.

10.5 Shade Fabric. Textilene fabric or equal shall be woven from .025 PVC coated yarn in a one over one plain weave. The yarn is composed of pigmented vinyl (80%) and 1000 denier polyester core yarn (20%±). Fabric shall have the following properties:

Weight	17 oz. per sq. yd.
Flame Retardance	Self Extinguishing
Grab Tensile Strength	400 lbs. Warp. 336 lbs. Fill
Trapeloid Tear Strength	200 lbs. Warp/145 lbs. Fill
Stretch	4.5%
Set	2%
Abrasion Resistance	No Rupture
(500 Taber Cycles)	Trace Wear
U.V. Deterioration	No Face
(200 SFH)	96% Tensile Retention
Ball Burst	500 lbs. to Rupture
Fabric Color "A" Burgundy	T91DAS408
Fabric Color "B" Peach	T91DAS304

## 11. MATERIAL FINISH.

### 11.1 Base Coat.

11.1.1 Material shall be free of rust and scale prior to cleaning operation.

11.1.2 Prior to base coat, the material shall be carefully cleaned and phosphated.

11.1.3 Immediately after phosphating, the material shall be dried, coated with an electro-deposition base coat and thoroughly dried.

### 11.2 Top Coat.

11.2.1 The base coat material shall receive a polyester powder coated with an electro-deposition base coat and throughly dried.

11.2.2 The powder coat material shall be oven baked to a smooth, uniform surface appearance.

11.2.3 Final top coating thickness shall be a minimum of 2 mil on significant surfaces.

11.2.4 Color - Burgundy conforming to Fed. Spec. #11105 (See SECTION: PAINTING, GENERAL).

## 12. ERECTION.

12.1 The erector must examine the space frame supports and the areas and conditions under which the space frame work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

12.2 Erect space frames and accessory items in accordance with manufacturer's erection drawings and as directed by manufacturer's recommendations.

12.3 Chords and webs with their quarter nodes shall be assembled in their final positions, working from scaffolding, or they shall be assembled in a temporary location and craned into final position.

12.4 All framing work shall be true to line, level and plumb.

12.5 Care must be taken in erection sequences to ensure members are not positioned by the use of force in order to prevent secondary stresses.

12.6 Tightening of the member bolts shall be done in accordance with the specification for structural joint using ASTM A 325 or A 490 bolts (April 16, 1978).

12.7 Provide temporary bracing and supports as required to ensure frame stability during erection.

12.8 Completed space frames shall comply with approved erection tolerances and requirements.

13. CLEANING.

13.1 Upon completion of works contained in this specification, leave all work and premises clean and in satisfactory condition.

13.2 Touch-Up Paint. Immediately after assembly, apply air dry touch-up paint to members whose finish is damaged during erection.

14. INSPECTION. The completed space frame assembly shall undergo a final inspection by manufacturer's representative to certify the finished product has been erected in accordance with the manufacturer's shop drawings and these specifications.

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SECTION 15A

PLUMBING, GENERAL PURPOSE

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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 Specifications (Fed. Spec.).

QQ-C-40 & Am-2	Caulking: Lead Wool and Lead Pig
QQ-C-576b & Am-1	Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed, or Machined Edges, (Plate, Bar, Sheet, and Strip)
QQ-L-201f & Am-2	Lead Sheet
QQ-T-371C	Tin, Pig
TT-P-1536A	Plumbing Fixture Setting Compound
TT-S-00230C & Am-2	Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-001543A	Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
WW-C-440B & Am-2	Clamps, Hose, (Low-Pressure)
WW-N-351C & Int Am-1	Nipples, Pipe, Threaded
WW-P-541E/GEN	Plumbing Fixtures (General Specification)

WW-P-541/1B	Plumbing Fixtures (Water Closets) (Detail Specification)
WW-P-541/2B	Plumbing Fixtures (Urinals) (Detail Specification)
WW-P-541/4B	Plumbing Fixtures (Lavatories) (Detail Specification)
WW-P-541/6B	Plumbing Fixtures (Drinking Fountains) (Detail Specification)
WW-S-001912 & Am-1	Seat, Water Closet (Land Use)
WW-U-516B	Unions, Brass or Bronze, Threaded Pipe Connections, and Solder-Joint Tube Connections
WW-U-531F	Unions, Pipe, Steel or Malleable Iron. Threaded Connection, 150 Lb, 250 Lb and 300 Lb WSP
WW-V-35C	Valve, Ball

#### 1.2 Federal Standard (Fed. Std.).

H28 & Suppl 1A	Screw-Thread Standards for Federal Services
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#### 1.3 Military Specifications (Mil. Spec.).

MIL-T-27730A	Tape, Antiseize, Polytetrafluoroethylene, With Dispenser
MIL-V-29193	Valve, Flush (Flushometer), Water Closet, Urinal, and Service Sink

#### 1.4 American National Standards Institute (ANSI) Standards.

A13.1-1981	Scheme for the Identification of Piping Systems
A112.1.2-1973 (R 1979) & Errata	Air Gaps in Plumbing Systems
A112.6.1M-1979	Supports for Off-the-Floor Plumbing Fixtures for Public Use
A112.14.1-1975	Backwater Valves
A112.21.1M-1980	Floor Drains

A112.36.2M-1983	Cleanouts
A117.1-1980	Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People
B1.20.1-1983	Pipe Threads, General Purpose (Inch)
B16.3-1977	Malleable Iron Threaded Fittings Class 150 and 300
B16.4-1977	Cast Iron Threaded Fittings Class 125 and 250
B16.12-1983	Cast Iron Threaded Drainage Fittings
B16.15-1978	Cast Bronze Threaded Fittings, Class 125 and 250
B16.18-1984	Cast Copper Alloy Solder Joint Pressure Fittings
B16.21-1978	Nonmetallic Flat Gaskets for Pipe Flanges
B16.22-1980	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.23-1984	Cast Copper Alloy Solder Joint Drainage Fittings - DWV
B16.24-1979	Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
B16.29-1980	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
B16.39-1977	Malleable Iron Threaded Pipe Unions (Class 150, 250, and 300)
B31.1-1986	Power Piping

1.5 American Society of Sanitary Engineering (ASSE) Standards.

1001	Pipe Applied Atmospheric Type Vacuum Breakers (May 1966, Rev May 1982)
1003	Water Pressure Reducing Valves for Domestic Water Supply Systems (1964, Rev May 1981)
1011	Hose Connection Vacuum Breakers (Jun 1970)

1012 Backflow Preventers with Intermediate Atmospheric Vent (May 1972, Rev Sep 1978)

1018 Trap Seal Primer Valves (Nov 1975)

1.6 American Society for Testing and Materials (ASTM) Publications.

A 47-84	Ferritic Malleable Iron Castings
A 53-84a	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 74-82	Cast Iron Soil Pipe and Fittings
A 120-84	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
A 126-84	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A 183-83	Carbon Steel Track Bolts and Nuts
A 518-80	Corrosion-Resistant High-Silicon Iron Castings
A 536-84	Ductile Iron Castings
B 32-83	Solder Metal
B 42-85	Seamless Copper Pipe, Standard Sizes
B 43-85	Seamless Red Brass Pipe, Standard Sizes
B 88-83a	Seamless Copper Water Tube
B 306-83	Copper Drainage Tube (DWV)
B 370-84a	Copper Sheet and Strip for Building Construction
B 641-83	Seamless and Welded Copper Distribution Tube (Type D)
C 564-70 (R 1982)	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
C 599-70 (R 1984)	Process Glass Pipe and Fittings
D 1248-84	Polyethylene Plastics Molding and Extrusion Materials

D 1785-83	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D 2000-80	Rubber Products in Automotive Applications
D 2146-82	Propylene Plastic Molding and Extrusion Materials
D 2241-84	Poly(Vinyl Chloride) (PVC) Pressure-Rated Plastic Pipe (SDR Series)
D 2447-85	Polyethylene (PE) Plastic Pipe, Schedules 40 and 80 Based on Outside Diameter
D 2464-76	Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D 2466-78	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
D 2467-76a	Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D 2564-84	Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
D 2657-79	Heat-Joining Polyolefin Pipe and Fittings
D 2662-83	Polybutylene (PB) Plastic Pipe (SDR-PR)
D 2665-85	Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
D 2666-83	Polybutylene (PB) Plastic Tubing
D 2672-85	Solvent Cement Joint Sockets on Belled PVC Pressure Pipe
D 2683-85	Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
D 2737-85	Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
D 2846-82	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

- D 2855-83 Making Solvent-Cemented Joints With Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D 3000-73 (R 1981) Polybutylene (PB) Plastic Pipe (SDR-PR) Based on Outside Diameter
- 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 3212-81 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D 3261-85 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- D 3309-85b Polybutylene (PB) Plastic Hot- and Cold-Water Distribution Systems
- E 96-80 Water Vapor Transmission of Materials
- E 156-83 Determination of Phosphorus in High-Phosphorus Brazing Alloys (Photometric Method)
- F 437-82 Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F 438-82 Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
- F 439-82 Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F 441-84 Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- F 442-82 Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
- F 493-85 Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

1.7 American Water Works Association (AWWA) Standards.

B300-80	Hypochlorites
B301-81	Liquid Chlorine
C105-82	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
C203-78	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot-Applied
M20-73	Water Chlorination Principles and Practices

1.8 Foundation for Cross-Connection Control & Hydraulic Research (FCCHR) Publication.

Manual of Cross-Connection Control, (6th Ed., Aug 1979)

1.9 Manufacturers' Standardization Society of the Valve and Fittings Industry Inc. (MSS) Standards.

SP-44	Steel Pipe Line Flanges (1985)
SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture (1983)
SP-67	Butterfly Valves (1983)
SP-69	Pipe Hangers and Supports - Selection and Application (1983)
SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends (1984)
SP-71	Cast Iron Swing Check Valves, Flanged and Threaded Ends (1984)
SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service (1970)
SP-73	Silver Brazing Joints for Wrought Copper and Copper Alloy and Cast Copper Alloy Solder Joint Pressure Fittings (1982)
SP-78	Cast Iron Plug Valves, Flanged and Threaded Ends (1977)

SP-80	Bronze Gate, Globe, Angle and Check Valves (1979)
SP-83	Carbon Steel Pipe Unions Socket-Welding and Threaded (1976)
SP-84	Steel Valves - Socket Welding and Threaded Ends (1985)
SP-85	Cast Iron Globe and Angle Valves - Flanged and Threaded Ends (1985)

1.10 National Association of Plumbing-Heating-Cooling Contractors (NAPHCC) Standard.

National Standard Plumbing Code (1983)

1.11 National Electrical Manufacturers Association (NEMA) Standard.

250-1985 Enclosures for Electrical Equipment (1000 Volts Maximum)

1.12 National Sanitation Foundation (NSF) Testing Laboratory Standard.

14 Plastic Piping System Components and Related Materials (Oct 1965, Rev thru Dec 1980)

1.13 Plastic Pipe Institute (PPI) Manual.

Plastics Piping Manual (1st Ed., 1976)

1.14 Plumbing and Drainage Institute (PDI) Standards.

WH-201 Water Hammer Arresters (Rev 1977)

## 2. GENERAL REQUIREMENTS.

2.1 Standard Products. Material and equipment shall be the standard products of a manufacturer regularly engaged in their manufacture. Items of equipment shall be the standard products of a manufacturer engaged in the manufacture of the products. Threaded joints shall have American National taper pipe threads conforming to Fed. Std. H28 with graphite or inert filler and oil, with an approved graphite compound, or with polytetrafluoroethylene tape.

2.2 Verification of Dimensions. The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

2.3 Backflow. Protection against backflow and back-siphonage shall be provided in accordance with requirements of the NAPHCC National Standard Plumbing Code. Reduced pressure principle backflow preventers, atmospheric (nonpressure) type vacuum breaker, and pressure type vacuum breaker assemblies shall be in accordance with the Manual of Cross-Connection Control and shall be of a type tested,

approved, and listed by the Foundation for Cross-Connection Control & Hydraulic Research as an approved backflow prevention device. Hose connection vacuum breakers, pipe applied atmospheric type antisiphon devices, and backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE Standards.

3. SUBMITTALS. Shop drawings shall be submitted in accordance with the SPECIAL CLAUSES and shall consist of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Shop drawings shall be provided for the complete plumbing system and shall include piping layout and location of connections; dimensions for roughing-in, foundation, and support points; schematic (elementary) diagrams and wiring diagrams or connection and interconnection diagrams. Shop drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support method.

4. MATERIALS. Material shall be suitable for the pressures and temperatures encountered. Pipe, valves, and fittings shall conform to the respective publications and other requirements specified below.

4.1 Pipe and Fitting Material. Pipe material for various services shall be in accordance with Tables III and IV, attached to this section. Water service and waste pipe shall extend from approximately 6 inches above the lower floor or inside the structure wall to a point not less than 5 feet outside the structure. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable cold-water service shall bear the NSF seal "NSF-PW" and shall not be used in buildings greater than two stories in height excluding basement.

4.2 Flanges. Flanges shall be suitable for the required operating pressure and temperature conditions. Flange gaskets shall be fiber, plastic, or other synthetic material suitable for the service. Flanges shall be used on pipe sizes 3 inches and larger.

<u>Description</u>	<u>Standard</u>
Bronze Flanges and Flanged Fittings	ANSI B16.24
Steel Pipe Line Flanges	MSS SP-44
Gray Iron Castings for Valves, Flanges, and Pipe Fittings	ASTM A 126

4.3 Unions. Unions shall be used on pipe sizes 2-1/2 inches and smaller. Unions shall meet the dimensional requirements and tensile strength required by Fed. Spec. WW-U-531, and shall be suitable for the required operating pressure and temperature conditions.

<u>Description</u>	<u>Standard</u>
Unions, Brass or Bronze	Fed. Spec. WW-U-516
Carbon Steel Pipe Unions Socket-Welding and Threaded	MSS SP-83
Malleable Iron Threaded Pipe Unions	ANSI B16.39

#### 4.4 Pipe Nipples.

<u>Description</u>	<u>Standard</u>
Nipples, Pipe, Threaded	Fed. Spec. WW-N-351

4.5 Valves. Valves used for water service shall have the zinc content limited to 6 percent for the stem, body, bonnet, wedge, or disk in contact with the fluid.

<u>Description</u>	<u>Standard</u>
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves	Fed. Spec. WW-V-35
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves-Socket Welding and Threaded Ends	MSS SP-84
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ANSI A112.14.1
Water Pressure Reducing Valves	ASSE 1003

Trap Seal Primer Valves	ASSE 1018
Gray Iron Castings for Valves, Flanges, and Pipe Fittings	ASTM A 126

#### 4.6 Pipe Jointing Materials, Gaskets.

<u>Description</u>	<u>Standard</u>
Caulking, Lead Wool and Lead Pig	Fed. Spec. QQ-C-40
CISPI Patented Joint for use in Connection with Hubless Cast Iron Sanitary System	CISPI 310
Nonmetallic Gaskets for Pipe Flanges	ANSI B16.21
Neoprene Rubber Gaskets for Hub and Spigot Cast-Iron Soil Pipe and Fittings	CISPI HSN-85
Solder, Metal	ASTM B 32
Silver Brazing Joints for Wrought and Cast Solder-Joint Fittings	MSS SP-73
Phosphorus in High- Phosphorus Brazing Alloys	ASTM E 156
PTFE Tape, for use with Threaded Metal or Plastic Pipe	Mil. Spec. MIL-T-27730
Rubber Gaskets for Cast- Iron Soil-Pipe and Fittings	ASTM C 564
Lead Type I	Fed. Spec. QQ-C-40,
Copper Sheet Form, Light, Cold-Rolled Temper	Fed. Spec. QQ-C-576,
Flexible Elastomeric Seals	ASTM D 3139 or D 3212

Heat Joining of Polyolefin Pipe and Fittings	ASTM D 2657
Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components	ASTM D 3138
Plastic Solvent Cement for PVC Plastic Pipe	ASTM D 2564 and D 2855
Solvent Cements for Chlorinated Poly(Vinyl Chloride) CPVC Plastic Pipes and Fittings	ASTM F 493
Pipe Jointing Method for PP Plastic Pipe	Mechanical Joint or Electrical Fusion Coil Method
Pipe Jointing Method for High Silicon Content Cast-Iron Pipe	Manufacturer's Recommendation

#### 4.7 Miscellaneous.

<u>Description</u>	<u>Standard</u>
Pipe Threads (Except Dry Seal)	ANSI B1.20.1
Water Hammer Arrester	PDI WH-201
Copper, Sheet and Strip for Building Construction	ASTM B 370
Lead, Sheet	Fed. Spec. QQ-L-201, Grade B
Hose Clamps	Fed. Spec. WW-C-440
Supports for Off-The-Floor Plumbing Fixtures	ANSI A112.6.1M
Metallic Cleanouts	ANSI A112.36.2M
Plumbing Fixture Setting Compound	Fed. Spec. TT-P-1536, Type II
Tin, Pig	Fed. Spec. QQ-T-371

Coal-Tar Protective Coatings and Linings for Steel Water Pipelines	AWWA C203
Standard for Hypochlorites	AWWA B300
Standard for Liquid Chlorine	AWWA B301
Polyethylene Encasement for Ductile-Iron Piping	AWWA C105
Scheme for the Identifi- cation of Piping System	ANSI A13.1

5. PIPE HANGERS, INSERTS, AND SUPPORTS. Pipe hangers, inserts, and supports shall conform to MSS SP-58 and SP-69.

6. SPECIALTY VALVES. Specialty valves shall be provided on supplies to equipment and fixtures. Valves in connection with runouts, risers, branches, and mains shall be installed where indicated. Valves shall be gate valves, unless otherwise specified or indicated. Valves up to 3 inches shall be bronze, with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger in diameter shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application.

6.1 Backwater Valves. Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall normally be slightly open. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

6.2 Wall Faucets. Wall faucets with vacuum breaker backflow preventer shall be brass with 3/4-inch male inlet threads, hexagon shoulder, and 3/4-inch hose connection. Faucet handle shall be securely attached to stem.

7. FIXTURES. Fixtures shall be water conservation type, in accordance with the National Standard Plumbing Code appendix "D". Water closets shall be designed, manufactured, and installed so as to be operable and adequately flushed with no more than 3-1/2 gallons of water per flush. Fixtures for use by the physically handicapped shall be in accordance with ANSI A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be true and straight. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture shall be trapped. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers.

Internal parts of flush valves, and pop-up stoppers of lavatory waste drains, may contain Poly(Vinyl Chloride) PVC. Plumbing fixtures shall be as indicated in Table I attached at the end of this section of the specifications.

7.1 Lavatories. Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled.

7.2 Flush Valves. Flush valves shall have a nonhold-open feature with backcheck angle control stop and a vacuum breaker. Flush valves shall be large diaphragm type, having a minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. Flush valves shall conform to Mil. Spec. MIL-V-29193.

7.3 Traps. Unless otherwise specified herein, traps shall be copper alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be not less than 20-gage copper alloy with walls 0.032-inch within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and waste tubing connecting to wall with escutcheon shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

7.4 Backflow Preventers. Reduced pressure principle assemblies, double check valves assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed by the Foundation for Cross-Connection Control & Hydraulic Research. Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012. Hose connection vacuum breakers shall be in accordance with ASSE 1011. Pipe applied atmospheric type vacuum breakers shall be in accordance with ASSE 1001. Air gaps in plumbing systems shall be in accordance with ANSI A112.1.2.

## 8. DRINKING FOUNTAINS.

8.1 General. Drinking fountain assembly shall include the complete installation and provision of the following:

Drinking Fountain and Pedestal  
Flood Cleanouts

8.2 Drinking Fountains shall be finished, sized, and installed as shown on the drawings, and be fully handicap accessible. The pedestal and base plate shall be constructed of steel with a metallic-green polyurethane finish. The fountain shall contain an integral vandal-resistant, anti-squirt, polished - chrome plated bubbler. The receptor shall be stainless steel with a No. 4 satin finish. There shall be an integral waste strainer with a vent for quick drainage.

8.3 The floor cleanouts shall be installed as shown on the drawings.

8.4 Piping shall conform to applicable requirements of the SECTIONS: WATER LINES and PLUMBING, GENERAL PURPOSE.

## 9. DRAINS.

9.1 Floor Drains. Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ANSI A112.21.1M.

9.2 Drains and Backwater Valves. Drains shall be as specified and the service duty shall be as indicated. The size of the drains shall be determined by the branch sizes indicated. Drains and backwater valves installed in connection with waterproofed floors shall be equipped with bolted-type flashing clamping devices.

10. GENERAL INSTALLATION REQUIREMENTS. Installation shall be as required by the NAPHCC National Standard Plumbing Code, in accordance with manufacturer's recommendations, and as specified herein. Neither hubless cast-iron nor plastic pipe shall be installed under concrete floor slabs. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. Piping shall be connected to the exterior service lines or capped or plugged, if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Utilities shall be installed below the frostline. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. A gate valve or full port ball valve and drain on the water service line shall be installed inside the building as close to the floor or wall as possible.

10.1 Soil, Waste, Drain, and Vent Piping. Plastic soil, waste, drain, and vent piping shall not pass through roofs. Plastic soil, waste, drain, and vent piping shall be installed in fire rated pipe chases when passing through floors. Pipes passing through roofs shall be an approved metallic pipe suitable for the application and extending a minimum of one foot below roofs, unless otherwise specified. The extended height above the roof shall be in accordance with the National Standard Plumbing Code. Vent lines for corrosive waste systems shall be the same material as the corrosive waste system, except where plastic systems are installed, a corrosive resistant cast-iron pipe shall be extended through roof, separate from other vents. Cast-iron soil pipe hubs inside buildings shall be

extended a minimum of 6 inches above the lowest floor where the floor is supported on the ground, and a minimum of 6 inches above ground where the lowest floor is self-supporting.

## 10.2 Water Pipe, Fittings, and Connections.

10.2.1 Utilities. The piping shall be extended to fixtures, outlets, and equipment. The cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shut-off valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, and flush valves shall be anchored to prevent movement.

10.2.2 Cutting and Repairing. The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

10.2.3 Protection to Fixtures, Materials, and Equipment. Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

10.2.4 Mains, Branches, and Runouts. Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Care shall be taken not to weaken structural portions of the building. Above ground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings will be kept a sufficient distance from other work and other services to permit not less than 1/2-inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or prevent flexible movement of the lines. No water pipe shall be buried in floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

10.2.5 Pipe Drains. Pipe drains indicated shall consist of 3/4-inch hose bibb with renewable seat and gate valve or full port ball valve ahead of hose bibb. At other low points, 3/4-inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

10.2.6 Expansion and Contraction of Piping. Allowance shall be made throughout for expansion and contraction of water pipe. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.

10.2.7 Commercial-Type Water Hammer Arresters. Commercial-type water hammer arresters shall be provided on cold-water supplies and shall be located as indicated. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall be in accordance with PDI WH-201.

10.3 Joints. Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Threaded joints shall have American Standard taper pipe threads conforming to ANSI B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied. Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous, domestic cold-water systems in lieu of unions, welded, flanges, or threaded joints. Mechanical couplings will not be permitted in non-accessible places. The gasket shall be molded rubber conforming to ASTM D 2000, Grade No. 2CA615A15B44F17Z (maximum temperature of 230 degrees F.) or 3BA610A15B44Z (maximum temperature of 200 degrees F.). Coupling nuts and bolts shall be steel conforming to ASTM A 183. Fittings and coupling housing for grooved pipe shall be malleable iron conforming to ASTM A 47, Grade 35510, or ductile iron conforming to ASTM A 536, Grade 65-45-12. Mechanical couplings and fittings shall be of the same manufacturer. Unions and flanges shall not be concealed in walls, ceilings, or partitions. A dielectric union or flange shall be installed at the junction of dissimilar metals on pressure piping systems. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

10.3.1 Corrosive Waste Cast-Iron Soil Pipe. Joints for high-silicon, corrosive waste cast-iron soil pipe and fittings with hubs shall be made by packing the bottom half of the hub with specially treated pure non-asbestos packing, on top of which one inch of molten lead shall be poured and properly caulked. Joints for corrosive waste cast-iron soil pipe and fittings without hubs shall be made by using a corrosion-resistant, metal, mechanical compression-type coupling as described above, except that a polytetrafluoroethylene liner shall be provided inside the neoprene collar.

10.3.2 Copper Tube. Joints for copper tubing shall be made with soldered or brazed fittings. Tube shall be cut square with burrs removed. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering.

Care shall be taken to prevent annealing of tube and fittings when making connections. Solder joints shall be made with flux and wire form or paste-type solder. The flux for either 50/50 or 95/5 solder shall be mildly corrosive liquid or petroleum-based paste containing chlorides of zinc and ammonium. Core solder shall not be used. Excess solder shall be wiped from joint before solder hardens. Joints in copper tube 2-1/2 inches and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multiflame torch. Joint material shall be as follows:

Cold Water	95/5 Solder
DMV	95/5 Solder

95/5 indicates 95 percent tin--5 percent antimony solder in accordance with ASTM B 32.

10.3.3 Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Also branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed in accordance with the NAPHCC National Standard Plumbing Code using B-Cup series filler metal in accordance with MSS SP-73. Soldered joints will not be permitted.

10.3.4 Plastic Pipe. Joints for other plastic pipe shall be made in accordance with PPI Plastics Piping Manual. Joints for plastic pipe materials are made in the following manner.

<u>Pipe Material</u>	<u>Joint Method</u>
PVC and CPVC	Solvent Cement Elastomeric Threading Schedule 80 Pipe (Threading Schedule 40 Pipe is not Allowed) Flanged
PB	Socket Fusion Compression Type Coupling Plastic to Metal Transition Fitting

Threaded joints shall be used only where required for disconnection and inspection.

10.4 Dissimilar Pipe Materials. Connections between ferrous and nonferrous metallic pipe shall be made with dielectric unions or flanges. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose

10.5 Corrosion Protection for Pipe and Fittings. Buried cast-iron piping shall be completely encased in polyethylene tube or sheet in accordance with AWWA C105. Exterior surfaces of metallic pipe and fittings, except copper, and cast iron that are installed underground shall be thoroughly cleaned of foreign

matter by wire brushing and solvent cleaning. Using tape conforming to AWWA C203 and primer as recommended by the tape manufacturer, the pipe shall be primed and immediately wrapped with the tape, applied with a 50 percent overlap. Joints and fittings shall be covered with the same primer and tape. Fittings shall be coated and wrapped after piping has been tested. Pipe shall be coated and wrapped during installation.

10.6 Pipe Sleeves and Flashing. Pipe sleeves shall be furnished and set in their proper and permanent location.

10.6.1 Sleeve Requirements. Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4-inch clearance all-around between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated on the drawings and with sealants conforming to Fed. Specs. TT-S-00230 or TT-S-001543 and with a primer, backstop material and surface preparation as required. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

10.6.2 Flashing Requirements. Pipes passing through roof or floor waterproofing membrane shall be installed through a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches.

The flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. In addition, a waterproofing clamping flange shall be installed.

10.6.3 Waterproofing. Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from lead or soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of lead or sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be caulked with oakum and lead to form a seal.

10.6.4 Optional Counterflashing. Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

## 10.7 Supports.

10.7.1 General. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. All piping subjected to vertical movement when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

10.7.2 Pipe Hangers, Inserts, and Supports. Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and SP-69, except as modified herein.

10.7.2.1 Types 5, 12, and 26 shall not be used.

10.7.2.2 Type 3 may be used without saddles or shields on insulated pipe without vapor barrier, if the clamp bottom does not extend through the insulation and the tip clamp attachment does not contact the insulation during pipe movement.

10.7.2.3 Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

10.7.2.4 Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. The C-clamp body shall not be constructed from bent plate.

10.7.2.5 Type 20 attachments used on angles and channels shall be furnished with an added malleable iron heel plate or adapter.

10.7.2.6 Type 24 may be used only on trapeze hanger systems or on fabricated frames.

10.7.2.7 Type 39 saddles shall be used on 4 inch and larger insulated pipe.

10.7.2.8 Type 40 shields shall be used on insulated pipe smaller than 4 inch size.

10.7.2.9 Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over one foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over five feet apart at valves.

10.7.2.10 Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

10.7.2.11 Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

10.7.2.11.1 Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inch and larger, a type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inch, a type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

10.7.2.11.2 Where there are high system temperatures and welding to piping is not desirable, then the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

10.8 Welded Installation. Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ANSI B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded at no additional cost to the Government. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

10.9 Pipe Cleanouts. Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast brass or cast iron ferrule with countersunk cast brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single-story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium-plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron (or plastic).

11. FIXTURES AND FIXTURE TRIMMINGS. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets, shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed piping connections from the shut-off or stop valve to the fixture shall be polished chromium-plated copper tubing. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified.

Exposed fixture trimmings and fittings shall be chromium-plated or nickel-plated brass, with polished bright surfaces. Drain lines and water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown. Stops for water closet seats shall be installed on the wall.

11.1 Fixture Connections. Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made absolutely gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural-rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

11.2 Flush Valves. Flush valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve, with approved metal bracket. Flush valves for water closets shall be installed 39 inches above the floor. Stops for the water closet seat shall be installed on the wall.

11.3 Height of Fixture Rims Above Floor. Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ANSI A117.1.

11.4 Fixture Supports. Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

11.4.1 Support for Cellular-Masonry Wall Construction. Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

11.4.2 Wall-Mounted Water Closet Gaskets. Where wall-mounted water closets are specified in Table I, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair carrier manufacturer.

11.5 Backflow Prevention Devices. No plumbing fixture, equipment, or pipe connection shall be installed that will provide a cross connection or interconnection between a potable water supply and any source of non-potable water. The backflow prevention device shall be installed where indicated and located so that no part of the device will be submerged. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

11.6 Access Panels. Access panels shall be provided for concealed valves, controls, dampers, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in SECTION: MISCELLANEOUS METAL.

11.7 Sight Drains. Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

11.8 Traps. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps for acid-resisting waste shall be of the same material as the pipe.

## 12. IDENTIFICATION SYSTEMS.

12.1 Identification Tags. Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

13. ESCUTCHEONS. Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

14. PAINTING AND FINISHING. After field welding of house tank plates has been completed, interior and exterior seam surfaces shall be prepared, primed, and finished. Painting of pipes, hangers, supports, and other iron work, in concealed spaces or exposed, is specified in SECTION: PAINTING, GENERAL.

## 15. TESTS, FLUSHING, AND STERILIZATION.

15.1 Plumbing System. The plumbing system shall be tested in accordance with the NAPHCC National Standard Plumbing Code.

15.2 Defective Work. If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. No calking of screwed joints or holes will be acceptable.

15.3 System Flushing. After tests are completed, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until discharge water shows no discoloration. System shall be

drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building, due to the Contractor's failure to properly clean the piping system, shall be repaired by the Contractor. When the work is complete, the hot-water system shall be adjusted for uniform circulation. Flush valves and automatic control devices shall be adjusted for proper operation.

15.4 Operational Test. Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system.

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Operation of each floor and roof drain by flooding with water.
- f. Operation of each vacuum breaker and backflow preventer.

15.5 Sterilization. After pressure tests have been made, the entire domestic cold-water distribution system to be sterilized shall be thoroughly flushed with water of sufficient velocity until all entrained dirt and other foreign material have been removed, before introducing chlorinating material. The chlorinating material shall be either liquid chlorine conforming to AWWA B301 or hypochlorite conforming to AWWA B300. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to insure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being sterilized shall be opened and closed several times during the contact period to insure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6-hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The sterilizing shall be repeated until tests indicate the absence of pollution for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

TABLE I.

Plumbing Fixture Schedule			
"P" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
P-1	Water Closet - WWP541Floor Mounted, Siphon- jet, elongated bowl, top supply spud	SJEB201	Floor flange shall be copper, alloy, cast iron or plastic. Gasket shall be wax type. Bowl length 25-1/2 inches. Bowl width 14 inches.
	Seat -	WWS1912CEBX	Black plastic elongated seat, open front, without top cover, extended back and seat, check hinges with plastic surface.
	Flush Valve - M29193	1a3.5	Valve shall be large diaphragm or piston type with exposed oscillating handle. Fittings and trim shall be copper alloy or stainless steel.
P-2	Water Closet (Handicapped Type) WWP541/1	SJEB213	Same as P-1 except 18 inches high.
P-3 & P-4	Urinal WWP541/2		
	a. Wall-hung siphon jet with integral trap and extended shields	WHSJES1	Top supply connection, back outlet.
	b. Wall-hung washout with integral trap extended shields	WHW0003	Top supply connection, back outlet.

TABLE I. (Continued)

Plumbing Fixture Schedule			
"P" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
	Flush Valve M29193	1a1.5	Valve shall be large diaphragm or large piston type with exposed oscillating handle. Fittings and trim shall be copper or stainless steel.
P-5	Lavatories WWP541/4		Faucets shall be single center set type. Faucets shall have replaceable seats and lever type handles. Faucet handles shall be cast, formed or drop forged copper alloy.  Faucet shall be provided with metal replaceable cart-ridge type control units or metal cart-ridge units with diaphragm which can be removed and replaced without special tools. Cartridge type units shall be designed to prevent dripping & replacement of washers. Valves and handles shall be copper alloy. Interconnection between valves & spout for center

TABLE I. (Continued)

Plumbing Fixture Schedule			
"P" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
			<p>set type faucet shall be of rigid type metal tubing. Drains and jam nuts shall be cast wrought copper alloy. Waste traps and hexagonal nut slip joints shall be copper alloy. Strainer shall be copper alloy or corrosion-resisting steel.</p> <p>Escutcheons shall be corrosion-resisting steel or copper alloy. Fixtures shall be supported by wall hangers.</p>
	<p>All sink depths shall be manufacturers standard.</p> <p>a. Straight back Width = 20 inches Front to back = 18 inches Back height = 3-1/2 inches</p>		
	1. Enameled cast iron	108	
	2. Vitreous china	214	

TABLE I. (Continued)

Plumbing Fixture Schedule			
"p" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
	b. Ledge back Width = 20 inches Front to back = 18 inches Back height = 1-1/4 inches		
	1. Enameled cast iron	100	
	2. Vitreous china	218	
	c. Shelf back Width = 19 inches Front to back = 17 inches Back height = 3-1/2 inches		
	1. Enameled cast iron		
	2. Vitreous china	221	
	d. Counter top rectangular Width = 20 inches Front to back = 18 inches		
	1. Enameled cast iron	100	
	2. Vitreous china	200	

TABLE I. (Continued)

Plumbing Fixture Schedule			
"P" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
P-8	Drinking Fountains WWP541/6		All accessories including bubblers, stops, stream regulators, flow controls, handles, push buttons and traps shall be copper zinc alloy. Strainer and drain shall be copper zinc alloy or corrosion-resisting steel. Automatic stream regulators or flow control shall be incorporated in the bubbler. Surface-mounted fountains shall have concealed fasteners. Fountains shall have a simple bubbler and shall be for exterior installation. Self closing valves shall have push button or cross shaped index metal turn handle without hood. Drain outlet will be suitable for the installation. Exposed surfaces or corrosion-resisting steel fountains shall have No. 4 general polish finish.

TABLE I. (Continued)

Plumbing Fixture Schedule			
"P" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
	a. Surface mounted Width = 13-1/4 inches. Front to back = 13 inches Height = 10 inches		
	1. Vitreous china	A0112	
	2. Corrosion resisting steel	A0212a	
	3. Enameled cast iron	A0312f	
	b. Semi-recessed Width = 14 inches Front to back = 11 inches Height = 26-5/8 inches		
	1. Vitreous china	B0111	
	2. Corrosion-resisting steel	B0211a	
	3. Enameled cast iron	B0311f	
	c. Recessed Width = 16-3/4 inches Front to back = 11 inches Height = 30 inches		
	1. Vitreous china	C0111	

TABLE I. (Continued)

Plumbing Fixture Schedule			
"P" No.	Description and DPN Number	Spn No. or Classification	Requirements or Remarks
	2. Corrosion-resisting steel	C0211a	
	3. Enameled cast iron	C0311f	
P-6	Wheelchair Lavatory WWP541/9 Vitreous china Width = 20 inches Front to back = 27 inches	Type III Class 2 Control-A	Lavatory trim and trap shall be chrome plated copper alloy. Gooseneck spout with wrist action handles and grid strainer. Mounting height above floor will be 34 inches to top edge of slab at front of the lavatory.

TABLE II. Materials for Drainage, Waste, and Vent Piping Systems.

		SERVICE					
Item No.	Pipe Material	A	B	C	D	E	F
1	Steel pipe, seamless galvanized, ASTM A 120, or ASTM A 53, Type S, Grade B		X		X	X	
2	Seamless red brass pipe, ASTM B 43				X	X	
3	Bronze flanged fittings, ANSI B16.24 for use with Items 2 and 5				X	X	
4	Cast copper alloy solder joint pressure fittings, ANSI B16.18 for use with Item 5				X	X	
5	Seamless copper pipe, ASTM B 42				X	X	
6	Cast bronze threaded fittings, ANSI B16.15				X	X	
7	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
8	Wrought copper and wrought copper alloy solder-joint drainage fittings. ANSI B16.29	X	X	X	X	X	
9	Cast copper alloy solder joint drainage fittings, DWV, ANSI B16.23	X	X	X	X	X	
10	Poly(Vinyl Chloride) plastic drain, waste and vent pipe and fittings, ASTM D 2665		X		X	X	
11	Process glass pipe and fittings, ASTM C 599						

TABLE II. (Continued)

Item No.	Pipe Material	SERVICE					
		A	B	C	D	E	F
12	High-silicon content cast-iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518						X

- A - Underground Building Soil, Waste and Storm Drain  
 B - Aboveground Soil, Waste, Drain In Buildings  
 C - Underground Vent  
 D - Aboveground Vent  
 E - Interior Rainwater Conductors Aboveground  
 F - Corrosive Waste And Vent Above And Belowground  
 \* - Hard Temper

TABLE III. Materials for Pressure Piping Systems.

SERVICE					
Item No.	Pipe Material	A	B	C	D
1	Malleable-iron threaded fittings, galvanized, ANSI B16.3 for use with Item 2	X	X	X	X
2	Steel pipe.				
	a. Seamless, galvanized, ASTM A 120, or ASTM A 53, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 120, or ASTM A 53, Type S, Grade B			X	
3	Seamless red brass pipe, ASTM B 43	X		X	X
4	Bronze flanged fittings, ANSI B16.24 for use with Items 3 and 5	X	X		X
5	Seamless copper pipe, ASTM B 42	X	X		X
6	Seamless copper water tube, ASTM B 88	X*	X*	X**	X**
7	Seamless and welded copper distribution tube (Type D) ASTM B 641	X	X		X
8	Cast bronze threaded fittings, ANSI B16.15 for use with Items 3 and 5	X	X		X
9	Wrought copper and bronze solder-joint pressure fittings, ANSI B16.22 for use with Items 6 and 7	X	X	X	X
10	Cast copper alloy solder-joint pressure fittings, ANSI B16.18 for use with Items 6 and 7	X	X	X	X

TABLE III. (Continued)

Item No.	Pipe Material	SERVICE			
		A	B	C	D
11	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			
12	Polyethylene (PE) plastic pipe (SDR-PR), Based on controlled outside diameter, ASTM D 3035	X			
13	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 11, 12 and 15	X			
14	Socket-Type Polyethylene Fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 12.	X			
15	Polyethylene (PE) plastic tubing, ASTM D 2737		X		
16	Polybutylene (PB) plastic pipe (SDR-PR), ASTM D 2662	X	X		
17	Polybutylene (PB) plastic pipe (SDR-PR) based on outside diameter, ASTM D 3000	X	X		
18	Polybutylene (PB) plastic tubing, ASTM D 2666	X			
19	Chlorinated Poly(Vinyl Chloride) (CPVC) plastic hot-water distribution system, ASTM D 2846	X	X		
20	Chlorinated Poly(Vinyl Chloride) (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441	X	X		

TABLE III. (Continued)

SERVICE					
Item No.	Pipe Material	A	B	C	D
21	Chlorinated Poly(Vinyl Chloride) (CPVC) plastic pipe (SDR-PR) ASTM F 442	X	X		
22	Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) plastic pipe fittings, Schedule 80, ASTM F 437 for use with Items 20, 21 and 22	X	X		
23	Socket-type Chlorinated Poly(Vinyl Chloride) (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21 and 22	X	X		
24	Socket-type Chlorinated Poly(Vinyl Chloride) (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21 and 22	X	X		
25	Poly(Vinyl Chloride) (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			
26	Poly(Vinyl Chloride) (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			
27	Poly(Vinyl Chloride) (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			
28	Socket-type Poly(Vinyl Chloride) (PVC) plastic pipe fittings, Schedule 80, ASTM D 2467	X			
29	Threaded Poly(Vinyl Chloride) (PVC) plastic pipe fittings, Schedule 80, ASTM D 2464	X			

TABLE III. (Continued)

SERVICE				
Item No.	Pipe Material	A	B	C D
30	Bell-end Poly(Vinyl Chloride) (PVC) pipe, ASTM D 2672	X		

- A - Cold Water Aboveground
- B - Hot Water 180 F. Maximum Aboveground
- C - Compressed Air Nonoil-Free
- D - Cold Water Service Belowground
- \* - Type M - Hard
- \*\* - Type L - Hard

\* \* \* \* \*

SECTION 16A

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

Index

- |                                      |                            |
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| 6. Cables, General Requirements      | 14. Tests                  |
| 7. Low-Voltage Cables                | 15. Painting and Finishing |
| 8. Duct Lines                        |                            |

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 Specification (Mil. Spec.).

DoD-P-21035A

Paint, High Zinc Dust Content,  
Galvanizing Repair (Metric)

1.2 Federal Specifications (Fed. Spec.).

W-C-375B/GEN

Circuit Breakers, Molded Case; Branch  
Circuit and Service (General  
Specification)

W-F-1814A/GEN  
& Suppl 1

Fuses, Cartridge, High-Interrupting  
Capacity

W-S-610C  
& Am-1

Splice Conductor

FF-P-101F

Padlocks

1.3 American Association of State Highway and Transportation Officials (AASHTO) Publications.

Standard Specifications for Highway Bridges (1983, 13th Ed.;  
Interim Specifications - Bridges 1984)

LTS-1

Structural Supports for Highway Signs,  
Luminaires, and Traffic Signals  
(1975, 1st Ed.; with Revisions  
contained in HB-12 Interim Specs  
1978 & 1979)

1.4 American National Standards Institute, Inc. (ANSI) Standards.

C2-1984

National Electrical Safety Code

C78.380-1984	Method for the Designation of High-Intensity Discharge Lamps
C80.1-1983	Rigid Steel Conduit - Zinc Coated
C82.4-1985	Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple Supply Type)
C119.1-1974	Sealed Insulated Underground Connector Systems Rated 600 Volts
C136.2-1985	Voltage Classification of Luminaires Used in Roadway Lighting Equipment
C136.3-1984	Luminaire Attachments Used in Roadway Lighting Equipment
C136.6-1984	Interchangeability of Metal Heads and Reflector Assemblies Used in Roadway Lighting Equipment
C136.9-1984	Mechanical Interchangeability of Socket Support Assemblies for Use in Metal Heads Used in Roadway Lighting Equipment
C136.10-1979	Physical and Electrical Interchangeability of Photocontrol Devices, Plugs, and Mating Receptacles Used in Roadway Lighting Equipment
C136.11-1979	Multiple Sockets Used in Roadway Lighting Equipment
C136.14-1980	Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity Discharge Lamps Used in Roadway Lighting Equipment
C136.15-1986	Field Identification of High-Intensity Discharge and Low-Pressure Sodium Lamps in Luminaires Used in Roadway Lighting Equipment
Z35.1-1972	Accident Prevention Signs

1.5 American Society for Testing and Materials (ASTM) Publications.

A 36-87	Structural Steel
A 48-83	Gray Iron Castings

- |  |   |
|--|---|
| A 123-84   | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products                   |
| A 153-82<br>(R 1987)   | Zinc Coating (Hot-Dip) on Iron and Steel Hardware                               |
| B 8-86   | Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft           |
| B 117-85   | Salt Spray (Fog) Testing  |
| D 1654-79a<br>(R 1984)   | Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments   |
| 1.6 Factory Mutual System (FM) Publication.  |   |
| Approval Guide (Equipment, Materials, Services for Conservation of Property) 1986 with Quarterly Supplements |   |
| 1.7 Illumination Engineering Society (IES) Publication.  |   |
| RP-8-1983  | Roadway Lighting  |
| 1.8 Institute of Electrical and Electronics Engineers (IEEE) Standards.                                      |   |
| No. 142-1982   | Recommended Practice for Grounding of Industrial and Commercial Power Systems   |
| 1.9 National Electrical Manufacturers Association (NEMA) Standards.  |   |
| AB 1-1986<br>(R 1981)<br>Incl Rev 1 thru 3   | Molded Case Circuit Breakers  |
| FB 1-1983<br>(R 1984)  | Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies |
| ICS 6-1983<br>Incl Rev 1   | Inclosures for Industrial Controls and Systems                                  |
| PB 1-1984  | Panelboards   |
| TC 6-1983  | PVC and ABS Plastic Utilities Duct for Underground Installation                 |
| 1.10 National Fire Protection Association (NFPA) Standard.   |   |
| 70-1987<br>& Errata<br>& Int Am 87-1<br>& Int Am 8-2   | National Electrical Code  |

1.11 Underwriters Laboratories Inc. (UL) Publications.

Electrical Construction Materials Directory (May 1986 with Quarterly Supplements)

- UL 6 Rigid Metal Conduit (Oct 23, 1981, 9th Ed.; Rev Oct 10, 1983; Errata Aug 29, 1986)
- UL 57 Electric Lighting Fixtures (Aug 30, 1972, 12th Ed., Erratum Sept 23, 1975, Rev thru July 22, 1982)
- UL 198E Class R Fuses (Apr 22, 1982, 3rd Ed.; Rev thru Sep 4, 1987)
- UL 467 Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev thru Apr 30, 1985)
- UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors (Nov 24, 1980, 7th Ed.; Rev thru Feb 19, 1987)
- UL 486B Wire Connectors for Use with Aluminum Conductors (Apr 13, 1982, 2nd Ed.; Rev thru Feb 18, 1986)
- UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures (Sept 15, 1986, 7th Ed.; Rev thru Dec 28, 1987, Errata Dec 24, 1986)
- UL 506 Specialty Transformers (Dec 26, 1979, 9th Ed.; Rev thru Oct 27, 1987)
- UL 514 Metallic Outlet Boxes (Dec 1, 1983, 7th Ed.; Rev thru Feb 10, 1987)
- UL 854 Service-Entrance Cables (Feb 9, 1987, 7th Ed.; Rev thru Feb 10, 1987)
- UL 1242 Intermediate Metal Conduit (Oct 10, 1983, 1st Ed.; Rev Apr 10, 1986)
- UL 1571 Incandescent Lighting Fixtures (Feb 7, 1984, 2nd Ed.; Rev thru Mar 31, 1987)
- UL 1572 High Intensity Discharge Lighting Fixtures (Dec 10, 1984, 2nd Ed.; Rev thru Jul 27, 1987)

2. GENERAL REQUIREMENTS. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 Code Compliance. The installation shall comply with the requirements and recommendations of NFPA No. 70 and ANSI C2.

2.2 Standard Product. 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.

2.3 Nameplates. Each major component of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment. Nameplates for individual items of electrical equipment shall be as specified in referenced publications and shall be provided on each item of equipment.

2.4 Prevention of Corrosion.

2.4.1 Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

2.4.2 Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123 and A 153.

2.4.3 Luminaires fabricated from ferrous metals, unless hot-dip galvanized or of porcelain enamel finish, shall be factory finished with a weather-resistant finish in accordance with paragraph: PAINTING AND FINISHING, except exposure shall be 200 hours. Finish color shall be the manufacturer's standard, unless otherwise indicated.

2.5 Unusual Service Conditions. Items furnished under this section shall be specifically suitable for the following unusual service conditions.

2.5.1 Altitude. 1500 feet above sea level.

2.5.2 Ambient Temperature. 45°C.

2.6 Verification of Dimensions. The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3. SUBMITTALS.

3.1 Proof of Compliance. Where materials or equipment are specified to conform to the standards or publications, and requirements of AASHTO, ANSI, ASTM, AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to conform to a Fed. Spec., the Contractor shall submit proof that the items furnished under this section of the specifications conform to the specified requirements. The label of, or listing in the Electrical Construction Materials Directory of UL or listing in the Approval

Guide of FM or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance.

3.2 Shop Drawings. After receiving complete material lists and before installation of any of these items, the Contractor shall submit complete shop drawings and such other descriptive data as the Contracting Officer may require to demonstrate compliance with the contract documents as required by the CONTRACT CLAUSES and the SPECIAL CLAUSES. Shop drawings shall be submitted for the following items and such other items as the Contracting Officer may direct.

- a. Weatherproof pedestal with meter sockets.
- b. Lighting poles.
- c. Area-lighting luminaires, and mounting brackets.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons therefore, shall be submitted with the shop drawings. Approved departures shall be made at no additional cost to the Government.

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, the name of the manufacturer of each such item.

3.4 Instruction Manuals. Six copies of instruction manuals shall be furnished within 7 calendar days 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 contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instruction manuals shall be submitted within 30 calendar days following the approval of the manuals.

3.5 Manufacturer's Certifications.

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

3.5.2 Certified Factory Test Reports. Certified factory test reports shall be submitted when manufacturers perform routine factory tests normally performed by the manufacturer, including tests required by standards listed in paragraph: APPLICABLE PUBLICATIONS. Additional certification is required to verify each transformer has passed a production line impulse test consisting of one reduced-wave and one full-wave lightning impulse test on each fully-insulated high-voltage terminal.

3.6 Contractor's Data. The Contractor shall submit the following types of data to supplement the manufacturer's data and drawings and Contractor's drawings.

3.6.1 Certifications. Certifications shall be submitted when specified or required, including Certification of the Qualifications of Medium-Voltage Cable Installers, Certified Factory and Field Test Reports, and Certificates of Compliance submitted in lieu of other proofs of compliance with these contract provisions.

3.6.2 Certified Field Test Reports. Field tests shall be made and test reports shall be written and certified by the Contractor to the Contracting Officer. Field tests shall include cable, operational, and resistance-to-ground tests.

3.7 Contractor's Drawings. The Contractor shall submit drawings as required to supplement contract drawings, manufacturer's data and drawings, and Contractor's data to demonstrate compliance with applicable contract requirements. Drawings shall be dimensioned or scaled to show the relative arrangement and mounting details of the equipment or equipment assemblies.

4. MATERIALS AND COMPONENTS. Materials and equipment shall conform to the following requirements.

4.1 Cables. Cables shall be of annealed copper, except that 1350 alloy aluminum conductors may be used as an equivalent for copper conductors of No. 6 AWG and larger. Intermixing of copper and aluminum conductors in these sizes is not permitted, except at connections to conductors not provided under this contract. Design is based on copper conductors and aluminum conductors shall have an ampacity not less than that of the indicated copper conductors. Cables shall be single-conductor type, unless otherwise indicated.

4.1.1 Low-Voltage Cables. Low-voltage cables shall conform to UL 854 for Type USE service entrance cable and shall utilize either cross-linked, thermosetting-polyethylene or ethylene-propylene-rubber insulation.

4.1.2 Grounding Cables. Grounding cables shall be bare, except where installed in conduit with associated phase conductors. Insulated cable shall be of the same material, green color-coded, and shall be insulated to match associated phase conductors, except that cable need be rated no more than 600 volt. Bare cables shall be ASTM B 8 soft-drawn unless otherwise indicated; aluminum is not acceptable.

4.2 Cable Joints, Terminations, and Connectors.

4.2.1 Connectors for Low-Voltage Cables. Fed. Spec. W-S-610; UL 486A for copper conductors and UL 486B for aluminum conductors; and ANSI C119.1 for sealed insulated connectors.

4.3 Cast Iron. ASTM A 48, Class 30B, minimum.

4.4 Concrete. Concrete shall be 2500 psi at 28 days as specified in SECTION: CONCRETE. Duct liner shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

4.5 Conduit and Fittings, Steel.

4.5.1 Conduit, Intermediate Metal. UL 1242.

4.5.2 Conduit, Rigid. ANSI C80.1 and UL 6.

4.5.3 Conduit Outlets and Fittings. NEMA FB 1, and UL 514.

4.6 Duct and Conduit Caulking Compound. Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F., shall not slump at a temperature of 300 degrees F., and shall not harden materially when exposed to the air. Compounds shall readily caulk or adhere to clean surfaces of asbestos-cement, fiber, or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

4.7 Duct and Fittings, Nonmetallic Type for Installation Underground. Wall thicknesses and fittings shall be suitable for the application. Ducts shall be single, round-bore type. Ducts shall be of the same material when used for applications requiring the same type of wall thickness.

4.7.1 Plastic. NEMA TC 6. Conduit fittings shall conform to the applicable NEMA standards, except that where NEMA standards for conduit fittings do not exist for the type of plastic installed, fittings shall be as recommended by the conduit manufacturer.

4.8 Grounding and Bonding. Equipment, UL 467. Wire, ASTM B 8, softdrawn copper. All connections below grade shall be fusion welded. Connections above grade shall be fusion welded or connectors in accordance with UL 467 and any other special requirement (such as UL approved for use with "MasterLabel" lightning protection systems, NEMP, communications, etc.)

4.9 Lamps and Ballasts, High-Intensity-Discharge Type. Lamps shall be suitable for the burning position used. Ballasts shall conform to ANSI C82.4; shall be coordinated to the lamp the ballast supplies; shall be rated for the voltage indicated; and shall have a power factor of not less than 90 percent, a crest factor of 2.0 or less, and a voltage range of not less than plus or minus 10 percent. Ballasts shall be suitable for operating at 5 degrees F. and above.

4.9.1 High-Pressure Sodium Lamps. ANSI C78.380, designation S50VA-250, installed where indicated.

4.10 Luminaire Components, Area Lighting.

4.10.1 Luminaires. Attachments, ANSI C136.3. Classification, ANSI C136.2. Field identification marking, ANSI C136.15. Interchangeability, ANSI C136.6 for metal heads and reflectors, and ANSI C136.9 for sockets. Luminaires, side-mounted, ANSI C136.14. Sockets, ANSI C136.11.

4.10.2 Photometric Distribution Classification. IES RP-8.

4.11 Luminaires.

4.11.1 High-Intensity-Discharge and Incandenscent. UL 57, UL 1571, UL 1572.

4.12 Nameplates. Nameplates shall be made of corrosion-resistant metal with not less than 1/4-inch tall raised or engraved characters. The nameplate shall be mounted on the front of the enclosure.

4.13 Padlocks. Padlocks shall conform to Fed. Spec. FF-P-101, type and size as determined by the Contracting Officer.

4.14 Electrical Enclosures. NEMA ICS 6, type as specified. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer.

4.15 Poles.

4.15.1 Metal. Poles shall be steel.

4.16 Protective Apparatus and Metering Devices.

4.16.1 Circuit Breakers, Low-Voltage. Molded-case, NEMA AB 1 and UL 489.

4.16.2 Fuses, Low-Voltage, Current-Limiting Types. Fed. Spec. W-F-1814, Class L or UL 198E, Class R.

4.16.3 Panelboards. NEMA PB 1.

4.17 Transformers, Specialty. UL 506

4.18 Warning Signs, High-Voltage. ANSI Z35.1, porcelain enameled steel or approved equal.

5. GENERAL INSTALLATION REQUIREMENTS. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of SECTION: ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of SECTION: CONCRETE FOR BUILDING AND RETAINING WALL CONSTRUCTION.

6. CABLES, GENERAL REQUIREMENTS. The type of installation, sizes, and number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber, laminated plastic, or nonferrous-metal tags, or approved equal, in each manhole, each handhole, each

junction box, and at each terminal. Loads shall be divided as evenly as practicable on the various phases of the system. Manufacturer's written recommendations shall be furnished for each type of splice and medium-voltage cable joint and termination, and for fireproofing application methods, and shall be approved before any work is done. Medium-voltage cable joints and terminations shall be the standard product of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Medium-voltage cable joints shall be made by qualified cable splicers. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and techniques recommended by the manufacturer. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

6.1 Duct Line Installation. Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and ground conductors shall be installed in the same duct with their associated phase conductors.

6.2 Connection to Buildings. Cables shall be extended into the various buildings as indicated, and shall be properly connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under SECTION: ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

7. LOW-VOLTAGE CABLES. Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 Volts. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of Fed. Spec. W-S-610 and conforming to the applicable requirements of UL 486A. Splices in wires No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, Type II, Class 2 of Fed. Spec. W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. All splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

8. DUCT LINES. Duct lines shall be nonencased direct-burial, thick-wall type. Where installed under roads or paved vehicular traffic areas, thick-wall type ducts shall also be concrete encased. Concrete encased ducts shall extend at least one foot beyond the edge of paving.

8.1 Requirements. Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3-inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be

used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes. Duct line markers shall be provided as indicated at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

8.2 Treatment. Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have diameters 1/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

8.3 Concrete Encasement. Each single duct shall be completely encased in concrete with a minimum of 3 inches of concrete around each duct, except that only 2 inches of concrete are required between adjacent electric power. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad crossings, tops of concrete encasements shall be not less than 18 inches below finished grade or paving. At railroad crossings, duct lines shall be encased with concrete, reinforced as indicated, and tops of concrete encasements shall be not less than 5 feet below tops of rails, unless otherwise indicated. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials, placed not further apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

8.4 Nonencased Direct-Burial. Top of duct lines shall be below frost line but not less than 24 inches below finished grade. Ducts shall be buried below frost line but in the earth and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand or stone-free earth, 3-inch layers of sand or stone-free earth shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts in direct-contact tiered fashion. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 4-inch layer of backfill cover shall be sand or stone-free earth compacted as previously specified. Duct banks

may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling. Selected earth at duct banks shall be thoroughly tamped in 4- to 6-inch layers.

8.5 Installation of Couplings. Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved. In the absence of specific recommendations, various types of duct joint couplings shall be made watertight as specified.

8.5.1 Plastic Duct. Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

9. TRANSFORMER STATIONS. Transformer stations shall be of the outdoor type having the ratings specified and shall be installed by Arizona Public Service (APS). Concrete pads shall be installed by the Contractor per APS requirements.

#### 10. METER PEDESTAL.

10.1 General. Meter pedestals shall be NEMA 3R raintight and suitable for service equipment. Meter pedestals shall be of the concrete-base-mounted type, consisting of a meter section and panelboard section, assembled as a single integral unit in a substantial weatherproof and tamperproof metal enclosure. The metal enclosure shall have locking provisions and shall be provided with a 2-inch padlock. Exterior shall have rust inhibiting primer and two coats of dark green enamel. Interior finish shall be white enamel. Arrangement shall be as shown. Meter installation shall meet APS requirement. Panelboard shall be circuit breaker equipped, Type I. Circuit breaker interrupting capacities shall conform to Fed. Spec. W-C-375 unless otherwise indicated. Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Plug-in type circuit breakers are not acceptable. Directories shall be typed to indicate load served by each circuit and mounted in holder behind protective covering.

10.2 Installation. Meter pedestals shall be mounted on a concrete base, reinforced as indicated. The top of the concrete base shall be as shown. The base shall be of adequate size to project beyond the equipment and sloped to drain. Concrete shall be 3000 psi minimum at 28 days. The metal enclosure shall be secured to the concrete base by a minimum of 4-1/2-inch galvanized anchor bolts.

#### 11. LIGHTING.

11.1 Area Lighting Luminaires. Area luminaires shall be of the enclosed type each consisting of a cast aluminum housing, a finished aluminum reflector for corrosion protection, an enclosing glass refractor or globe providing the indicated IES RP-8 type light distributions, and a slip-fitter capable of adapting to 1-1/4-inch through 2-inch mounting brackets. Luminaire heads shall have standard dimensions suitable for interchangeable, standard optical assemblies. Heads shall be internally wired and rated 600 volts. Where indicated, luminaires shall be equipped with weatherproof plug-in or twist-lock receptacles to receive photo-control elements. Lamps shall be of the sizes and types indicated and provided with appropriate ballasts.

11.2 Vandal-Resistant Construction. Where indicated, luminaires shall be provided with vandal-resistant construction. Exposed diffusers, reflectors, or refractors shall be of a polycarbonate resin, except that other material may be used if protected by a polycarbonate resin shield or cast metal guard. Luminaires mounted 15 feet and less above grade shall have exposed screws of the tamper-resistant type.

11.3 Time-Control. Where indicated, luminaires shall be group controlled by astronomic, electrically wound time switches having 20-minute carry-over features and automatic adjustment provisions to allow for seasonal changes of sunset and sunrise. Adjustable settings shall allow turning on either 20 or 40 minutes before or after sunset, in addition to sunset, and adjustable off positions shall allow turning off from 8:30 p.m. to 2:30 a.m., in addition to sunrise. Three-position key-operated control switches marked ON, OFF, and AUTOMATIC shall be provided for override of time-control systems. Time switches may directly control opening and closing of lighting circuits if switches provided have an adequate rating. Where switches do not have such a rating, contactors of adequate rating and of the required number of poles shall be provided. Time-control equipment assemblies shall be mounted integrally in an enclosure suitable for outdoor operation.

11.4 Poles. Lighting poles shall be steel, a nominal 30 feet in length. Poles shall be suitable for use with underground supply conductors. Poles shall be designed for a wind velocity of 100 mph at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-1. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. Bases shall be of the anchor-bolt-mounted type. The type of pole shaft material provided shall not be mixed on any project.

11.4.1 Brackets. Brackets for area lighting shall be of the indicated types. Brackets for area luminaires shall correctly position luminaires not less than the indicated number of feet from poles, at not less than the mounting heights indicated, but in no case less than 24 feet above any roadway. Slip-fitter brackets shall be coordinated with the luminaires provided, and brackets used with one type of luminaire shall be identical. Brackets shall be not less than 2-inch galvanized steel pipe or equivalent aluminum. On metal poles, brackets shall be of the same metal.

11.4.2 Steel Poles. Steel poles and steel brackets shall be hot-dip galvanized in accordance with ASTM A 123 and shall not be painted.

11.4.3 Pole Setting. Poles shall be mounted on cast-in-place or precast screw foundations. Where indicated, concrete poles shall be embedded in accordance with the details shown. Conduit ells shall be provided for cable entrances into pole interiors.

11.4.3.1 Cast-In-Place Foundations. Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufacturers' standard, and not less than necessary to meet the pole wind loading specified herein and other design requirements.

11.4.3.2 Power-Installed Screw Foundations. Power-installed screw foundations having the required strength and mounting-bolt, top plate dimensions may be utilized. Screw foundations shall be of at least 1/4-inch thick structural steel conforming to ASTM A 36 and hot-dip galvanized in accordance with ASTM A 123. Conduit slots in screw foundation shafts shall be approximately 18 inches below tops of shafts on opposite sides and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of any screw foundation is permitted.

12. CONCRETE PULLBOXES. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers. Concrete reinforcing shall be that which is regularly used in the standard products of the manufacturer. Pullbox tops shall be flush with sidewalks or curbs or placed 1/2-inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked Low-Voltage and provided with two lifting eyes and two hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

13. GROUNDING. Neutral conductors, cable shields, metallic cable sheaths and armor, metallic conduits, cable terminations, junction boxes, poles, surge arresters, fencing enclosing electrical equipment, and other noncurrent-carrying metallic parts of equipment shall be grounded.

13.1 General Requirements. A resistance of not greater than 25 ohms shall be provided, unless otherwise specified. Ground resistances shall be measured in normally dry conditions not less than 48 hours after rainfall. Resistances of systems requiring separate ground rods, rather than a counterpoise, shall be measured separately before bonding below grade. The combined ground resistance of separate systems bonded together below grade may be used to meet the specified ground resistance, but the minimum number of rods indicated must still be provided.

13.1.1 Ground Rods. Ground rods shall be copper-clad steel, and shall be not less than 3/4 inch in diameter by 8 feet in length. Unless otherwise indicated, ground rods shall be driven into the ground until tops of rods are approximately 1 foot below finished grade. In counterpoise systems, tops of ground rods shall be approximately at elevations of counterpoises. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional ground rods, longer ground rods, or deep-driven sectional rods shall be installed and connected until the specified resistance is obtained, except that not more than three additional 8-foot ground rods shall be required at any one installation. Ground rods shall be spaced as evenly as possible at least 6 feet apart and connected 2 feet below grade.

13.1.2 Connections. Connections above grade shall be made with bolted solderless connectors and those below grade shall be made by a fusion-welding process. In lieu of a fusion-welding process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire. Where ground wires are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be utilized.

13.2 Neutral Grounding. Neutral conductors shall be grounded where indicated. Ground wires shall be not less than No. 1/0 AWG, except that where the rated phase current exceeds 400 amperes, the size of neutral ground wires shall be increased to not less than one-half the size of the cross-sectional area of the individual phase conductors. Neutral ground wires shall be protected by conduit where such wires run exposed above grade in non-fence-enclosed areas or are run through concrete construction. Where concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground wire and the opening shall be sealed with a suitable compound after installation of the ground wire. Bends greater than 45 degrees in ground wire connections to the ground rods or counterpoises are not permitted.

13.3 Equipment Grounding. Equipment frames of metal-enclosed equipment, metal splice boxes, and other noncurrent-carrying metal items, shall be grounded unless otherwise indicated. Connections to earth shall be made in the same manner as required for neutral grounding. Equipment or devices operating at less than 750 volts may be connected to secondary neutral grounds. Equipment operating at more than 750 volts to ground shall be provided with grounds separate from secondary neutral grounds, but both grounds shall be bonded together below grade at the ground rods or may utilize a common counterpoise.

13.4 Lighting Pole Grounding. Bases of lighting poles shall be connected to an adjacent ground rod by means of a No. 8 AWG wire. A ground connection from poles back to neutral ground points shall also be provided utilizing either metal raceways or ground wires.

13.5 Handhole, or Concrete Pullbox Grounding. Ground rods installed in electrical-distribution-system handholes, or concrete pullboxes shall be properly connected to the cable shielding, metallic sheath, and armor at each cable joint or splice by means of No. 4 AWG or equivalent braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Ground wires shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

13.6 Metal Splice Box Grounding. Metal splice boxes for medium-voltage direct-burial cable shall be grounded by connection to a ground rod located within 2 feet of each splice box using a ground wire having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

13.7 Transformer Station Grounding. Transformers shall be grounded per APS requirements.

#### 14. TESTS.

14.1 Operating Test. After the installation is completed, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test.

14.2 Ground-Resistance Measurements. Ground-resistance measurements of each ground rod shall be taken and certified by the Contractor to the Contracting Officer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Contracting Officer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground or part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground-resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in IEEE No. 142.

15. PAINTING AND FINISHING.

15.1 Factory Coating. Equipment and component items, including, but not limited to ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 125 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with Table 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to Mil. Spec. DoD-P-21035.

15.2 Field Painting. Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in SECTION: PAINTING, GENERAL.

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SECTION 16B

ELECTRICAL WORK, INTERIOR

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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 Specifications (Fed. Spec.).

J-C-30A & Am-1	Cable and Wire, Electrical (Power, Fixed Installation)
L-C-530B & Am-1 & Int Am-2	Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy
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
W-B-30A & Am-2	Ballast, Fluorescent Lamp (Non-Polychlorinated Biphenyl Type)
W-C-586C	Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal
W-C-596F/GEN & Suppl 1	Connector, Electrical, Power, General Specification for
W-C-1094A	Conduit and Conduit Fittings Plastic, Rigid
W-F-406C	Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible

W-F-408D	Fittings for Conduit, Metal, Rigid (Thick-Wall and Thin-Wall (EMT) Type)
W-F-414E & Int Am-1	Fixture, Lighting (Fluorescent, Alternating-Current, Pendant Mounting)
W-F-1662A & Int Am-2	Fixture, Lighting (Fluorescent, Alternating-Current, Recessed and Surface Ceiling)
W-J-800E & Am-1	Junction Box. Extension, Junction Box; Cover, Junction Box (Steel Cadmium, or Zinc Coated)
W-L-101H & Suppl. 1	Lamps, Incandescent (Electric, Large, Tungsten-Filament)
W-L-00116D	Lamps, Fluorescent (General Specifi- cation)
W-P-455A & Am-6	Plate, Wall, Electrical
W-S-610C & Am-1	Splice Conductor
HH-I-553C & Am-1	Insulation Tape, Electrical (Rubber, Natural and Synthetic)
HH-I-595C	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
WW-C-566C	Conduit, Metal, Flexible

1.2 American National Standards Institute, Inc. (ANSI) Standards.

C78.380-1984	Method for the Designation of High-Intensity Discharge Lamps
C82.4-1985	Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple Supply Type)

1.3 American Society for Testing and Materials (ASTM) Publication.

D 69-85	Friction Tapes
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1.4 Institute of Electrical and Electronics Engineers (IEEE) Standard.

No. 142-1982	Recommended Practice for Grounding of Industrial and Commercial Power Systems
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1.5 National Electrical Manufacturers Association (NEMA) Standards.

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)

1.6 National Fire Protection Association (NFPA) Publications.

70-1987	National Electrical Code
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1.7 Underwriters Laboratories Inc. (UL) Publications.

Building Materials Directory (Jan 1986 with Quarterly Supplements)	
UL 6	Rigid Metal Conduit (Oct 23, 1981, 9th Ed.; Rev Oct 10, 1983; Errata Aug 29, 1986)
UL 57	Electric Lighting Fixtures (Aug 30, 1972, 12th Ed.; Erratum Sep 23, 1975; Rev thru Jul 22, 1982)
UL 360	Liquid-Tight Flexible Steel Conduit (Aug 18, 1986, 3rd Ed.)
UL 467	Grounding and Bonding Equipment (Nov 22, 1984, 6th Ed.; Rev Apr 30, 1985)
UL 498	Attachment Plugs and Receptacles (Sep 17, 1981, 10th Ed.; Rev thru Sep 24, 1984; Errata Jul 23, 1986)
UL 797	Electrical Metallic Tubing (Oct 10, 1983, 5th Ed.)
UL 943	Ground-Fault Circuit Interrupters (Sep 11, 1985, 2nd Ed.)
UL 1029	High-Intensity-Discharge Lamp Ballasts (Aug 25, 1980, 3rd Ed.; Rev thru May 16, 1983)
UL 1242	Intermediate Metal Conduit (Oct 10, 1983, 1st Ed.; Rev Apr 10, 1986)
UL 1570	Standard for Fluorescent Lighting Fixtures (Nov 22, 1982, 2nd Ed.; Rev thru Sep 16, 1985)

## 2. GENERAL.

2.1 Rules. The installation shall conform to the requirements of NFPA 70, unless more stringent requirements are indicated herein or shown.

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 conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

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. When the nameplate is to be installed on an irregular shaped object, the Contractor shall devise an approved support suitable for the application. In all instances, the nameplate shall be installed in a conspicuous location. 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.

3. APPROVAL OF MATERIALS AND EQUIPMENT. Materials and equipment will be approved based on the manufacturer's published data.

3.1 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 Non-Underwriters Laboratories Inc. (UL) Publications. For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers, or other commercial standard, is acceptable.

3.3 Shop Drawings. Shop drawings shall be submitted for approval in accordance with the SPECIAL CLAUSES and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required. Shop drawings shall be submitted for all materials and equipment specified. Drawings shall show applicable schematic diagrams; equipment layout and anchorage; and conduit and cable trays runs, anchorage, and support.

4. WORKMANSHIP. Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

5. MATERIALS AND EQUIPMENT shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section.

5.1 Ballasts.

5.1.1 Fluorescent Lamp Ballast. High-power-factor type conforming to Fed. Spec. W-B-30, Class P, automatic-resetting type.

5.1.2 High-Intensity-Discharge Lamp Ballast. UL 1029 and ANSI C82.4 for multiple supply type.

5.2 Cables. Cables shall conform to Fed. Spec. J-C-30 and shall be of annealed copper, except that 1350 alloy aluminum conductors may be used as an equivalent for copper conductors of No. 6 AWG or larger. Intermixing of copper and aluminum conductors in these sizes is not permitted. Design is based on copper conductors and aluminum conductors shall have an ampacity not less than that of the indicated copper conductors. Cables shall be single-conductor type, unless otherwise indicated.

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

5.3 Conduit.

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

5.3.2 Rigid Metal Conduit. UL 6.

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

5.3.4 PVC Coated Rigid Steel Conduit. NEMA RN 1.

5.3.5 Intermediate Metal Conduit. UL 1242.

5.3.6 Conduit Coatings.

- 5.3.6.1 Plastic Resin System. Fed. Spec. L-C-530, Type I; or 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.
- 5.3.6.2 Epoxy System. Fed. Spec. L-C-530, Type II.
- 5.4 Connectors, Wire Pressure. Fed. Spec. W-S-610.
- 5.5 Device Plates. Fed. Spec. W-P-455.
- 5.6 Fittings, Cable and Conduit. Fed. Spec. W-F-406 and W-F-408.
- 5.7 Fixtures. Standard Drawings 40-06-04 and UL 57, unless otherwise specified.
  - 5.7.1 Fluorescent, General-Purpose Fixtures. Fed. Spec. W-F-414, Type II, style A, B, C and D, W-F-1662, and UL 1570.
  - 5.7.2 High-Intensity-Discharge Fixtures. UL 1572.
- 5.8 Lamps.
  - 5.8.1 Fluorescent Lamps. Fed. Spec. W-L-116.
  - 5.8.2 High-Intensity-Discharge Lamps. ANSI C78.380.
  - 5.8.3 Incandescent Lamps, Large, Fed. Spec. W-L-101H.
- 5.9 Outlets.
  - 5.9.1 Conduit, Cast-Metal or Malleable Metal. Fed. Spec. W-C-586.
- 5.10 Outlet Boxes.
  - 5.10.1 Sheet-Steel Outlet Boxes. Fed. Spec. W-J-800.
- 5.11 Receptacles.
  - 5.11.1 General Grade Receptacles. Fed. Spec. W-C-596.
  - 5.11.2 Standard Grade Receptacles. UL 498.
  - 5.11.3 Ground Fault Interrupters. UL 943, Class A or B.
- 5.12 Splice, Conductor. Fed. Spec. W-S-610.
- 5.13 Tapes.
  - 5.13.1 Friction Tape. ASTM D 69.
  - 5.13.2 Plastic Tape. Fed. Spec. HH-I-595.
  - 5.13.3 Rubber Tape. Fed. Spec. HH-I-553.
- 5.14 Tubing, Electrical, Zinc-Coated Steel (EMT). UL 797.

## 5.15 Grounding and Bonding Equipment. UL 467.

5.15.1 Ground Rods. Ground rods shall be of copper-clad steel not less than 3/4-inch in diameter, 8 feet long, driven full length into the earth.

5.15.2 Ground Bus. The ground bus shall be bare conductor or flat copper 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. Except where specifically indicated otherwise, all exposed noncurrent carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways, and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall extend to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flange connection. Metallic water service shall be grounded as described by NFPA 70. Generally all supplemental grounding electrodes shall be ground rods. Where there are no metallic water services to the building, ground connections shall be made to driven rods on the exterior of the building.

6.1 Ground Rods. The maximum resistance measured in accordance with IEEE No. 142 of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, \_\_\_\_\_ additional rods not less than 6 feet on centers, or if sectional type rods are used, two additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

6.2 Ground Bus. Ground bus shall be provided as indicated. 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 ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor.

## 7. WIRING METHODS.

7.1 General Requirements. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, or intermediate metal conduit.

7.2 Conduit and Tubing Systems. Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on conductor insulation types as described in paragraph: WIRING METHODS. 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 will not be installed in damp or wet locations. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by the NFPA 70. 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 duct system shall be suitable for installation in wet locations.

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 polyvinyl chloride, plastic resin, epoxy coating system.

7.2.2 Installing in Slabs Other Than on Grade. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer.

7.2.3 Exposed Raceways. Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.

7.2.4 Changes in Direction of Runs. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

7.2.5 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 the NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the NFPA 70. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. 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.

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 from panel to load center, shall be No. 10 AWG.

7.4.2 The conductor sizes are based on the use of TW insulation for conductors smaller than No. 1/0 AWG and THW insulation for conductors No. 1/0 AWG and larger, except where otherwise indicated. Other acceptable NFPA 70 types of insulated conductors of equivalent ampacity may be substituted.

7.4.3 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.

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

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. 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.

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. Boxes for metallic raceways, 4-inch by 4-inch nominal size and smaller, 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. Large size boxes shall be NEMA 1 or as shown. Boxes in other locations shall be sheet steel except that nonmetallic boxes may be used with nonmetallic-sheathed or metallic-armored cable system. In partitions of light steel construction bar hangers with 1-inch long studs, mounted between metal wall studs or metal stud "C" brackets snapped on and tab-locked to metal wall studs, shall be used to secure boxes to the building structure. When "C" brackets are used, additional box support shall be provided on the side of the box opposite the brackets. The edge of boxes for electrical devices shall be flush with the finished surfaces in gypsum, plasterboard installation. Boxes for mounting lighting fixtures shall be not less than 4 inches square except that smaller boxes may be installed as required by fixture configuration, as approved. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. 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 shall be mounted 48 inches above finished floors. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. 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 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. Cast-metal boxes with 3/32-inch wall thickness are acceptable. 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.

8.1 Boxes for Use with Raceway Systems. Boxes for use with raceway systems shall be not less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Sheetmetal boxes for other than lighting-fixtures 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. Minimum size boxes for telephone outlets shall be not smaller than 4-1/2 inches square and 3-1/2 inches deep.

8.2 Boxes for Use with Cable Systems. Boxes for use with cable systems shall be not less than 3- by 2-inch sectional boxes, 2 inches deep.

8.3 Pull Boxes. Pull boxes of not less than the minimum size required by the NFPA 70 shall be constructed of aluminum or 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.

8.4 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 of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact resistant plastic and shall be brown. 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 and provided with a hinged, gasketed cover, unless otherwise specified. Device plates for telephone and intercommunication outlets shall have a 3/8 inch bushed opening in center.

#### 10. RECEPTACLES.

10.1 Single and Duplex Receptacles. Single and duplex receptacles shall be rated 15 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of brown 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 suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the class and current rating as indicated.

11. UNDERGROUND-SERVICE CONDUITS. Empty conduits for underground electric-service cable shall be installed. Except where otherwise indicated, conduits shall terminate approximately 5 feet beyond the building wall and 2 feet below finished grade, with the outside ends bushed and plugged or capped.

12. LAMPS AND LIGHTING FIXTURES. Fixtures may be provided with No. 18 AWG stranded copper conductors in 3/8-inch flexible metal conduits not over 6 feet long where flexible metal conduits are permitted by NFPA 70. Ballasted fixtures

shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

12.1 Lamps. Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

12.1.1 Fluorescent lamps shall have standard cool-white color characteristics and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved.

12.1.2 High-intensity-discharge lamps shall be the high-pressure-sodium type unless otherwise indicated, shown, or approved.

12.2 Fixtures. Fixtures shall be as shown and shall conform to the following specifications. Fixtures of similar designs and equivalent energy efficiency, light-distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved.

12.2.1 Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

13. EQUIPMENT CONNECTIONS. 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 conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. Liquid-tight conduits shall be used in damp or wet locations.

14. PAINTING AND FINISHING. Field-applied paint on exposed surfaces shall be provided under SECTION: PAINTING, GENERAL.

15. 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. No part of the electrical distribution system shall be energized prior to the resistance testing of that systems ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the rod and the resistance and the soil conditions at the time the test was performed.

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