Reference: DACW09-90-B-0029

SPECIFICATIONS

for

ARIZONA CANAL DIVERSION CHANNEL

(Cudia City Wash To Dreamy Draw, Including Cudia City Wash Sediment Basin)

Maricopa County, Arizona

Authority: Public Law 89–298, Flood Control Act of 1965

Appropriation: 96x3122 Construction General Corps of Engineers, Civil

96x8862 Contributed Funds, Other

US Army Corps of Engineers

Los Angeles District

SOLICITATION, OFFER, AND AWARD *(Construction, Alteration, or Repair)*	1. SOLICITATION NO.	2. TYPE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES
	DACW09-90-B-0029	[X] SEALED BID (IFB) [ ] NEGOTIATED *(RFP)*	2 July 1990	1 of 3

IMPORTANT – The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.

7. ISSUED BY CODE	8. ADDRESS OFFER TO
U.S. ARMY ENGINEER DISTRICT, LOS ANGELES P.O. Box 2711 Los Angeles, California 90053-2325	U.S. ARMY ENGINEER DISTRICT, LOS ANGELES Phoenix Office 3636 N. Central Avenue, Room 760 Phoenix, Arizona 85012-1936

9. FOR INFORMATION CALL:	A. NAME	B. TELEPHONE NO. *(Include area code) (NO COLLECT CALLS)*
	See "INSTRUCTIONS TO BIDDERS"	

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying no., date)*:

ARIZONA CANAL DIVERSION CHANNEL (CUDIA CITY WASH TO DREAMY DRAW), Maricopa County, Arizona

Work consists of earthwork, including excavation and compacted fill; disposal of excess excavated material; concrete channel; fencing; landscaping and recreation facilities; utilitiy lines and appurtenant works.

The estimated cost of construction is over $10,000,000.

11. The Contractor shall begin performance within 5 calendar days and complete it within ** calendar days after receiving [ ] award, [X] notice to proceed. This performance period is [X] mandatory, [ ] negotiable. *(See* * SPECIAL CLAUSES *.)*

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? *(If "YES," indicate within how many calendar days after award in Item 12B.)*	12B. CALENDAR DAYS
[X] YES [ ] NO	10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and no copies to perform the work required are due at the place specified in Item 8 by 1:00 PM *(hour)* local time 16 August 1990 *(date)*. If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee [X] is, [ ] is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 60 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
	16. REMITTANCE ADDRESS *(Include only if different than Item 14)*
CODE 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 *(Type or print)*	20B. SIGNATURE	20C OFFER DATE

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED:

22. AMOUNT	23 ACCOUNTING AND APPROPRIATION DATA

24 SUBMIT INVOICES TO ADDRESS SHOWN IN ▶ *(4 copies unless otherwise specified)*	ITEM	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 253(c) ( )
26. ADMINISTERED BY CODE		27. PAYMENT WILL BE MADE BY

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 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.

☐ 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.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*		31A. NAME OF CONTRACTING OFFICER *(Type or print)*	
30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE

STANDARD FORM 1442 BACK (REV. 4-8

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, _____ (name), certify that I am the _____ Secretary of the corporation named as offeror in the within offer; that _____ (name), who signed said offer on behalf of the corporation, was then _____ (title) of said corporation; that the signature thereto 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

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
1.	DIVERSION AND CONTROL OF WATER	1	Job	L.S.	$_____
2.	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	Job	L.S.	_____
3.	EXCAVATION	1,774,000	Cu.Yd.	$_____	_____
4.	COMPACTED FILL, CHANNEL	415,300	Cu.Yd.	_____	_____
5.	COMPACTED FILL, BACKFILL TOE	3,600	Cu.Yd.	_____	_____
6.	SELECT FILL	17,320	Cu.Yd.	_____	_____
7.	CONCRETE, INVERT	88,800	Cu.Yd.	_____	_____
8.	CONCRETE, WALLS	75,600	Cu.Yd.	_____	_____
9.	CONCRETE, TOP SLAB	24,800	Cu.Yd.	_____	_____
10.	CONCRETE, DENTAL	300	Cu.Yd.	_____	_____
11.	COLOR ADMIXTURE	1	Job	L.S.	_____
12.	PORTLAND CEMENT	26,900	Cwt	_____	_____
13.	STEEL REINFORCEMENT	14,000	Ton	_____	_____
14.	OVERFLOW SPILLWAYS	1	Job	L.S.	_____
15.	ASPHALT CONCRETE PAVEMENT	4,000	Ton	_____	_____
16.	STEEL PICKET FENCE	1	Job	L.S.	_____
17.	SIDE DRAINS	1	Job	L.S.	_____
18.	MISCELLANEOUS HARDWARE	1	Job	L.S.	_____
19.	DRIVEWAY ENTRANCES	1	Job	L.S.	_____
20.	STATION MARKING	1	Job	L.S.	_____
21.	GAGING STATION	1	Job	L.S.	_____
22.	CUDIA CITY WASH SPILLWAY CONDUITS	1	Job	L.S.	_____

BIDDING SCHEDULE (Cont'd)

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
23.	INTAKE STRUCTURE	1	Job	L.S.	_____
24.	SHOTCRETE	1	Job	L.S.	_____
25.	MISCELLANEOUS ITEMS OF WORK	1	Job	L.S.	_____
26.	12TH STREET AND 16TH STREET UNDERPASS RAMPS	1	Job	L.S.	_____
27.	STONE	15,200	Ton	_____	_____
28.	GROUTING STONEWORK	3,200	Cu.Yd.	_____	_____
29.	CURB AND GUTTER	5,900	Lin.Ft.	_____	_____
30.	LANDSCAPING	1	Job	L.S.	_____
31.	IRRIGATION SYSTEM	1	Job	L.S.	_____
32.	SUBDRAINAGE SYSTEM	1	Job	L.S.	_____
33.	35TH STREET WASH DRAINAGE CULVERTS	1	Job	L.S.	_____
34.	MANHOLE ADJUSTMENTS	1	Job	L.S.	_____
35.	32ND STREET SANITARY SEWER	1	Job	L.S.	_____
36.	STANFORD DRIVE RECONSTRUCTION	1	Job	L.S.	_____
37.	24TH STREET DETOUR	1	Job	L.S.	_____
38.	24TH STREET SANITARY SEWER	1	Job	L.S.	_____
39.	35TH STREET SIDE DRAIN	1	Job	L.S.	_____
40.	LOW FLOW CHANNEL BRIDGES	1	Job	L.S.	_____

TOTAL ESTIMATED AMOUNT: $_____

NOTES: All extensions of the unit prices shown will be subject to verification by the Government. In case of variation between the unit price and the extension, the unit price will be considered to be the bid.

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

If a modification to a bid based on unit prices is submitted which provides for a lump sum adjustment to the total estimated amount, the application of the lump sum adjustment to each unit price in the Bidding Schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro-rata basis to every unit price in the Bidding Schedule.

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

* * * * *

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. AMENDMENTS TO INVITATIONS TO BIDS (DEC 1989) 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 this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid, (3) by letter or telegram, or (4) by facsimile, if facsimile bids are authorized in the solicitation. The Government must receive the acknowledgment 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 (DEC 1989) FAR 52.214-5.

4.1 Bids and bid modifications shall be submitted in sealed envelopes or packages (unless submitted by electronic means) (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.

4.3 Facsimile bids, modifications, or withdrawals, will not be considered unless authorized in the solicitation.

5. DIRECTIONS FOR SUBMITTING BIDS.

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

Bid Under Reference No:
(DACW09-90-B-0029)

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, 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
Brunswig Square Building, Room 308
360 East Second Street
Los Angeles, California 90013

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 (DEC 1989) 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 if authorized by the solicitation, was sent by telegram or via facsimile, 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, or

7.1.3 Was sent by U.S. Postal Service Express Mail Next Day Service-Post Office To Addressee, not later 5:00 P.M. at the place of mailing two working days prior to the date specified for receipt of bids. The term "working days" excludes weekends and U.S. Federal holidays.

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 both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date or 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 clerk to place a legible 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 The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by U.S. Postal Service Express Mail Next Day Service-Post Office To Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and both the postmark on the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph 7.3 of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

7.6 Notwithstanding paragraph 7.1 of this provision, 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.

7.7 Bids may be withdrawn by written notice or telegram (including mailgram) received at any time before the exact time set for receipt of bids. If the solicitation authorizes facsimile bids, bids may be withdrawn via facsimile received at any time before the exact time set for receipt of bids, subject to the conditions specified in the provision entitled "Facsimile Bids." 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 the 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 BOND (MAR 1989) DFARS 252.228-7007.

10.1 The Offeror (Bidder) shall furnish a separate bid bond, or United States bonds, Treasury notes or other public debt obligations of the United States, in the proper form and amount, by the time set for opening of bids. Failure to do so may be cause for rejection of the bid. The Contracting Officer will return bid bonds or notes of the United States (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.

10.2 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.

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

10.4 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. The bid bond, or bonds or notes of the United States, 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 252.210-7003. The specification, standards, plans, drawings, descriptions, and other pertinent documents cited in this solicitation may be examined at the following locations:

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

13. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE. Whenever a contract or modification of contract price is negotiated, the Contractor's cost proposals for equipment ownership and operating expenses shall be determined in accordance with the requirements of paragraph: EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE contained in the SPECIAL CLAUSES. 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. Individual copies of EP 1110-1-8 are available from the Government Printing Office (GPO) for $9.50. To order the publication telephone (202) 783-3228.

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: Mr. Neil Irwin, telephone (602) 261-3022.

17. DRAWINGS. Specifications with half-size drawings will be furnished upon receipt of payment of $40.00 per set. Full-size drawings will be furnished upon receipt of payment of $160.00 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 711, 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 prescribed 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, EFARS 14.406-2.

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:

(1) Obviously misplaced decimal points will be corrected;

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

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

(4) 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 PROTEST (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.

24. LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JAN 1990) FAR 52.203-12.

24.1 Definitions.

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal action," as used in this clause, means any of the following Federal actions:

(a) The awarding of any Federal contract.

(b) The making of any Federal grant.

(c) The making of any Federal loan.

(d) The entering into of any cooperative agreement.

(e) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to Influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a government duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

(a) An individual who is appointed to a position in the Government under title 5, United States Code, including a position under a temporary appointment.

(b) A member of the uniformed services, as defined in subsection 101(3), title 37, United States Code.

(c) A special Government employee, as defined in section 202, title 18, United States Code.

(d) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed," as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State," as used in this clause, means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

24.2 Prohibition.

(a) Section 1352 of title 31, United States Code, among other things, prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.

(b) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(c) The prohibitions of the Act do not apply under the following conditions:

(i) Agency and legislative liaison by own Employees.

(A) The prohibition on the use of appropriated funds, in subparagraph 24.2(b) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision 24.2(c)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

1 Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities.

2 Technical discussions and other activities regarding the application or adaptation of the person's products or services for an agency's use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action:

1 Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

2 Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

3 Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Public Law 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision 24.2(c)(i)(A) of this clause are permitted under this clause.

(ii) Professional and technical services by own Employees.

(A) The prohibition on the use of appropriated funds, in subparagraph 24.2(a) of this clause, does not apply in the case of--

1 A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

2 Any reasonable payment to person other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(B) For purposes of subdivision 24.2(c)(ii)(A) of this clause, "professional and technical services" shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance or operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of his or her client's proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an

engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.

(C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation, or reasonably expected to be required by law or regulation, and any other requirements in the actual award documents.

(D) Only those services expressly authorized by subdivision 24.2(c)(ii)(A) 1 and 2 of this clause are permitted under this clause.

(E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(iii) Disclosure.

(A) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph 24.2(a) of this clause, if paid for with appropriated funds.

(B) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under subparagraph 24.2(a) of this clause. An event that materially affects the accuracy of the information reported includes:

1 A cumulative increase of $25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or,

2 A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or,

3 A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

(C) The Contractor shall require the submittal of a certification,and if required, a disclosure form by any person who requests or received any subcontract exceeding $100,000 under the Federal contract.

(D) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosure forms to the Contracting Officer at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(iv) Agreement. The Contractor agrees not to make any payment prohibited by this clause.

(v) Penalties.

(A) Any person who makes an expenditure prohibited under paragraph 24.1 of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph 24.2 of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(B) Contractors may rely without liability on the representations made by their subcontractors in the certification and disclosure form.

(vi) Cost allowability. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

25. PLEDGES OF ASSETS (FEB 1990) FAR 52.228-11.

25.1 Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

(a) Pledge of assets; and

(b) Standard Form 28, Affidavit of Individual Surety.

25.2 Pledges of assets from each person acting as an individual surety shall be in the form of--

(a) Evidence of an escrow accounting containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government sureties held in book entry form) and/or;

(b) A recorded lien on real estate. The offeror will be required to provide--

(1) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owners; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(2) Evidence of the amount due under any encumbrance shown in the evidence of title;

(3) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

26. INDIVIDUAL SURETIES IN SUPPORT OF BIDS. Offerors utilizing individual sureties in support of a bid bond shall include a Standard Form (SF) 28, Affidavit of Individual Surety, accompanied by a pledge of acceptable assets from each person acting as an individual surety, and include these with the SF 24, Bid Bond, and the bid itself in accordance with the paragraph entitled PLEDGE OF ASSETS of the Instructions to Bidders. Pledge of acceptable assets shall be in the form of (1) evidence of an escrow account, and/or (2) a recorded lien on real estate. Failure to provide pledges of acceptable assets, with the bid, in the specified form, accompanied by a properly executed SF 24 and SF 28, will render the offeror nonresponsible, thus ineligible for award.

27. BIDDER'S QUALIFICATION. Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work.

28. PERFORMANCE EVALUATION OF CONTRACTOR.

28.1 As a minimum, 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.

28.2 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).

28.3 A similar evaluation for subcontractors will be prepared if the Government deems it to be appropriate.

* * * * *

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 that 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 (FEB 1990) FAR 52.219-1.

5.1 Representation. 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.

5.2 Definition. "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.

5.3 Notice. Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small business concern in paragraph 5.1 of this clause in order to obtain a contract to be awarded under the preference programs established pursuant to sections 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall (1) be punished by imposition of a fine, imprisonment, or both; (2) be subject to administrative remedies; and (3) be ineligible for participation in programs conducted under the authority of the Act.

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 Pacifc 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 NONSEGRATED 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 NON-SEGREGATED 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 (SEP 1989) FAR 52.204-3.

(a) Definitions.
"Common parent", as used in this solicitation provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.
"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 offeror 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 Federal, 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 contendre) 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 specitying 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 occuring 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 emplyee will --

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

(ii) Notify the employer of any criminal drug statute conviction for a violation occuring 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 occuring 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 16.2 or 16.3 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 fradulent certifications may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

17. COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (OCT 1987) DFARS 252.204-7007.

In the block with its name and address, the Offeror should supply the CAGE code applicable to that name and address. The CAGE code should be preceded by "CAGE:". If the Offeror does not have a CAGE code, the Offeror may request the Contracting Officer to initiate a DD Form 2051. The Contracting Activity will complete Section A and the Offeror must complete Section B of the DD Form 2051. A CAGE code will be assigned when a completed DD Form 2051 is received by the Defense Logistics Center, Attn: DLSC-FBA, Federal Center, 74 N. Washington, Battle Creek, MI 49017-3084. No Offeror should delay the submission of its offer pending receipt of its CAGE code.

18. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (MAY 1989) FAR 52.209-5.

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principles--

(A) Are _____ are not _____ presently debarred, suspedned, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have _____ have not _____, within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statues relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property; and

(C) Are _____ are not _____ presently indicated for, or otherwise criminally or civilly charged by a government entity with, commission of any of the offeses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has _____ has not _____, within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER TITLE 18, UNITED STATES CODE, SECTION 1001.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.
(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

19. CONTRACTOR ESTABLISHMENT CODE (AUG 1989) FAR 52.204-4.

19.1 In the block with its name and address, the offeror should supply the Contractor Establishment Code applicable to that name and address,if known, to the offeror. The number should be preceeded by "CEC:" Offerors should take care to report the correct CEC and not a similar number assigned to the Offeror in a different system.

19.2 The CEC is a 9-digit code assigned to a contractor establishment that contracts with a Federal executive agency. The CEC system is a contractor identification coding system which is currently the Dun and Bradstreet Datatification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings. (e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

20. NOTICE OF RESRTICTIONS ON CONTRACTING WITH SANCTIONED PERSONS (MAY 1989) FAR 52.225-12.

20.1 Statutory prohibitions have been imposed on contracting with sanctioned persons, as specified in Federal Acquisition Regulation (FAR) 52.225-13, Restrictions on Contracting with Sanctioned Persons.

20.2 By submission of this offer, the Offeror represents that no products or services, except those listed in this paragraph 20.2, delivered to the Government under any contract resulting from this solicitation will be products or services of

a sanctioned person, as defined in the clause referenced in paragraph 20.1 of this provision, unless one of the exceptions in paragraph (d) of the clause at FAR 52.225-13 applies.

Product or Service	Sanctioned Person

21. CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JAN 1990) FAR 52.203-11.

21.1 The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph 21.2 of this certification.

21.2 The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief as of December 23, 1989 that--

(1) No federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of $100,000 shall certify and disclose accordingly.

21.3 Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than $100,000, for each such failure.

22. HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (JUL 1989) EFARS 252.223-7004.

22.1 "Hazardous material", as used in this clause, includes the following:

(1) All items in, or ordinarily cataloged under, the Federal Supply Classes listed in Table I of Appendix A of the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract);

(2) Items having hazardous characteristics in the Federal Supply Classes listed in Table II of Appendix A of the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract);

(3) Any other item to be delivered under this contract which will contain hazardous material or expose Government personnel to those materials.

22.2 Each Offeror shall certify as follows:
The Offeror certifies that the material to be delivered ☐ is ☐ is not a hazardous material as defined in paragraph 22.1 above.

22.3 The apparently successful Offeror agrees to submit prior to award a Material Safety Data Sheet meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313 in effect on the date of this solicitation for all hazardous material(s) described in paragraph 22.1 above, unless the Offeror certifies in paragraph 22.2 above that the material is not hazardous. Data shall be submitted on all items included in the offer, whether or not the apparently successful Offeror is the actual manufacturer of these items. Failure to comply with this requirement shall result in the Offeror's being considered nonresponsible and ineligible for award.

22.4 If there is a change in the composition of the item(s) after award or a revision to Federal Standard No. 313 which renders incomplete or inaccurate the data submitted under paragraph 22.3 of this clause or the certification submitted under paragraph 22.2 of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

22.5 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.

22.6 Nothing contained in this clause shall relive the Contractor from complying with applicable Federal, state, or local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.

22.7 Notwithstanding any other clause in this contract, the Government's rights in the data furnished under this contract with respect to hazardous material are as follows:

(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 hazardous 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 purpose(s).

(2) That the Government is not precluded from using similar or identical data required from other sources.

* * * * *

CLAUSES INCORPORATED BY REFERENCE - Alternate I (JUN 1988) FAR 52.252-2.

This contract incorporates the following clauses (listed on Pages C-2 through C-5) 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)

The full text of these clauses may be obtained 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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GENERAL WAGE DECISION NO. AZ90-2

Supersedes General Wage Decision No. AZ89-2

State: ARIZONA

County(ies): Statewide

Construction Type: Heavy & Highway

Construction Description: Heavy & Highway Construction Projects

Modification Record:

No.	Publication Date	Page No.(s)

	Basic Hourly Rates	Fringe Benefits
BRICKLAYERS; Stonemasons:		
Northern Area:		
Zone A	14.95	2.39
Zone B	16.95	2.39
Zone C	17.95	2.39
Zone D	18.45	2.39
Zone E	20.45	2.39
Southern Area:		
Zone A:		
Bricklayers; Stonemasons	13.13	2.62
Manhole Builders	13.43	2.62
Zone B:		
Bricklayers; Stonemasons	13.50	2.62
Manhole Builders	13.80	2.62
Zone C:		
Bricklayers; Stonemasons	13.88	2.62
Manhole Builders	14.18	2.62
Zone D:		
Bricklayers; Stonemasons	14.63	2.62
Manhole Builders	14.93	2.62
CARPENTERS:		
Carpenters	14.28	3.00
Piledrivermen	14.79	3.00
MILLWRIGHTS:		
Northern Area	19.29	3.00
Central amd Southern Area	16.29	3.00
CEMENT MASONS:		
Zone 1:		
Northern Area:		
Cement Masons	18.505	3.05
Concrete Troweling Machine; Sawing and Scoring Machine; Curb and Gutter Machine	18.74	3.05
Central & Southern Areas:		
Cement Masons	16.005	3.05
Concrete Troweling Machine; Sawing and Scoring Machine; Curb and Gutter Machine	16.24	3.05
Zone 2:		
Cement Masons	16.445	2.62
Concrete Troweling Machine; Sawing and Scoring Machine; Curb and Gutter Machine; Clary and similar type of power Screed Operator	16.68	2.62
ELECTRICIANS:		
Area 1:		
Electricians	16.81	1.30+ 3.75%
Cable Splicers	18.16	1.30+ 3.75%
Area 2:		
Electricians' Technicians; Cable Splicers:		
Zone A	17.10	2.33+ 3.5%
Zone B	20.22	2.33+ 3.5%

Area 3:	18.74	12%+ 1.40
Area 4:		
Electricians on projects having an electrical contract value of less than $20 million	16.00	2.14+ 3%
Electricians on projects having an electrical contract value of $20 million or more	17.95	2.14+ 3%
Area 5:		
Electricians	17.00	1.00+ 11.5%
Cable Splicers	17.25	1.00+ 11.5%
IRONWORKERS:		
Northern Area	19.00	5.40
Southern Area	16.00	5.40
Central Area	16.00	5.40
LABORERS:		
Area 1:		
Group 1	13.08	2.77
Group 2	15.61	2.77
Group 3	16.19	2.77
Group 4	16.46	2.77
Group 5	18.01	2.77
Barricade Setter:		
Placement, removal, transport, and maintenance of the traffic control devices	5.90	1.27
Area 2:		
Group 1	10.58	2.77
Group 2	13.11	2.77
Group 3	13.69	2.77
Group 4	13.96	2.77
Group 5	15.51	2.77
Barricade Setter:		
Placement, removal, transport, and maintenance of the traffic control devices	5.90	1.27
(Tunnel and Shaft Work):		
Area 1:		
Group 1	15.985	2.77
Group 2	16.24	2.77
Group 3	16.44	2.77
Group 4	16.98	2.77
Group 5	17.295	2.77
Group 5A	17.655	2.77
Area: 2		
Group 1	13.485	2.77
Group 2	13.74	2.77
Group 3	13.94	2.77
Group 4	14.48	2.77
Group 5	14.795	2.77
Group 5A	15.155	2.77
LINE CONSTRUCTION:		
Zone 1:		
Groundmen	13.41	4.75+ 3.5%
Equipment Operator; Powdermen & Mechanics	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%
Zone 1-A:		
Groundmen	14.41	4.75+ 3.5%
Equipment Operator; Powdermen & Mechanics	16.74	4.75+ 3.5%
Linemen, Crane Operator, Sagger, and Pilot	18.15	4.75+ 3-1/2%
Cable splicers	19.73	4.75+ 3-1/2%
Zone 2:		
Groundmen	15.40	4.75+ 3-1/2%
Equipment Operator; Powdermen & Mechanics	17.74	4.75+ 3-1/2%
Linemen, Crane Operator, Sagger, and Pilot	20.12	4.75+ 3-1/2%
Cable splicers	20.67	4.74+ 3-1/2%
PAINTERS:		
Area 1:		
Zone A:		
Brush	11.60	1.90
Brush, Steel & Bridge	12.10	1.90
Spray	12.05	1.90
Spray, Steel & Bridge	12.60	1.90
Zone B: ($0.75 per hour above Zone A BHR)		
Zone C: ($1.75 per hour above Zone A BHR)		
Zone D: ($2.00 per hour above Zone A BHR)		
Area 2:		
Zone A:		
Brush and Roller; Sandblaster (Nozzleman); 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; Nozzleman and Pot Tender; Steel (steam cleaner); Electric and Air Tool Operator; Steel Sandblaster	14.67	1.30
Steel Sandblaster	14.67	1.30
Zone B: ($1.00 per hour above Zone A (BHR)		
Zone C: ($2.50 per hour above Zone A BHR)		
Area 3:		
Zone A:		
Brush	12.47	1.77
Spray; Sandblaster	13.07	1.77
Paperhanger	12.60	1.77
Swing Stage, under 40 feet:		
Brush	12.77	1.77
Spray	13.37	1.77

Swing Stage, over 40 feet:		
Brush	13.47	1.77
Spray	14.07	1.77
Structural Steel & Tanks:		
Brush	13.47	1.77
Spray & Sandblasters	14.07	1.77
Creosote Base and Bituminous material	12.87	1.77
Zone B: ($0.75 per hour above Zone A BHR)		
Zone C: ($1.50 per hour above Zone A BHR)		
Zone D: ($2.75 per hour above Zone A BHR)		
PLUMBERS AND PIPEFITTERS:		
Zone 1	16.50	4.43
Zone 2	19.50	4.43
Zone 3:		
Commercial	16.00	3.78
Industrial	19.34	3.78
POWER EQUIPMENT OPERATORS:		
Group 1	11.99	3.28
Group 2	14.66	3.28
Group 3	15.57	3.28
Group 4	16.42	3.28
TRUCK DRIVERS:		
Group 1	7.40	2.87
Group 2	10.50	2.87
Group 3	14.82	2.87
Premium Pay: Combination Man - $.30 per hr. over highest rated work. Multiple-Unit Equipment		

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

AREA DESCRIPTIONS

BRICKLAYERS; STONEMASONS:
Northern Area: Apache, Coconino and Gila Counties; Graham County (west and north of the San Francisco River to the Gila River); Greenlee County (west and north of the San Francisco River to the Gila River); Maricopa, Mohave, and Navajo Counties; Pinal County (north of a boundary line drawn west along the Gila River to the western City limits of Florence, a straight line from the extreme southwestern City limits of Florence to the extreme southern City limits of Coolidge, then a straight line to the extreme southern City limits of Casa Grande, with the line extending to the Maricopa/Pinal County Line); Yavapai, Yuma and La Paz Counties:

Zone A: 0-50 road miles from the City Hall in Phoenix
Zone B: 50-75 road miles from the City Hall in Phoenix
Zone C: 75-100 road miles from the City Hall in Phoenix
Zone D: 100-200 road miles from the City Hall in Phoenix
Zone E: 200 road miles and over from the City Hall in Phoenix

Southern Area: Cochise County; Graham County (east and south of the San Francisco River to the Gila River); Greenlee County (east and south of the San Francisco River to the Gila River); Pima County; Pinal County (south of a boundary line drawn west along the Gila River to the western City limits of Florence, a straight line from the extreme southwestern City limits of Florence to the extreme southern City limits of Coolidge, then a straight line to the extreme southern City limits of Casa Grande, with the line extending to the Maricopa/Pinal County Line); Santa Cruz Counties:

Zone A: 0-15 road miles from Tucson City limits
Zone B: 15-30 road miles from Tucson City limits
Zone C: 30-40 road miles from Tucson City limits
Zone D: Over 40 road miles from Tucson City limits

CARPENTERS:

Northern Area: Area north of a straight line drawn between a point 35 miles due north of the City Hall in Flagstaff and a point 35 miles due north of the City Hall in Kingman, extending to the Arizona/Nevada State Line on the west; and connecting to a point 35 miles due north of the City Hall in Holbrook, thence due east to the intersection of the Arizona/New Mexico State Line

Central and Southern Areas: All areas not included in the Northern Area

CEMENT MASONS:

Zone 1: Apache, Coconino, and Gila Counties; Graham County (north of Sentinel-Casa Grande-Safford Line); Greenlee County (north of Sentinel-Casa Grande-Safford Line); Maricopa County (north of Sentinel-Casa Grande-Safford Line); Mohave, and Navajo Counties; Pinal County (north of Sentinel-Casa Grande-Safford Line); Yavapai, Yuma and La Paz Counties:

NORTHERN AREA: Area North of a straight line drawn between a point 35 miles due north of the City Hall in Flagstaff, and a point 35 miles due north of the City Hall in Kingman, extending to the Arizona/Nevada State Line on the west and connecting to a point 35 miles due north of the City Hall in Holbrook, thence due east to the intersection of the Arizona/New Mexico State Line.

CENTRAL and SOUTHERN AREAS: All Areas not included in the NORTHERN AREA

Zone 2: Southern parts of Cochise, Graham, Greenlee, Maricopa, and Pinal Counties; Pima and Santa Cruz Counties

ELECTRICIANS:

Area 1: Apache County (north of Highway #66)

Area 2: Coconino County; Navajo County (north and west of a boundary line beginning at a point where Clear Creek crosses the Coconino/Navajo County Line and then extending in a northeasterly direction along Clear Creek and northeasterly to Cottonwood Wash, along Cottonwood Wash extending northeasterly to where it intersects the Navajo Indian Reservation, then easterly along the Navajo Indian Reservation boundary line to a point where it intersects the Navajo/Apache County Line):

Zone A: 5 miles north-south, east and west of the Post Offices of Williams, Sedona, and Winslow
Zone B: Remainder of Area 2 not covered by Zone A

Area 3: Apache County (south of Highway #66); Gila County; Navajo County (south and east of a boundary beginning at a point where Clear Creek crosses the Coconino/Navajo County Line, then extending in a northeasterly direction along Clear Creek and northeasterly to Cottonwood Wash, along Cottonwood Wash extending northeasterly to where it intersects the Navajo Indian Reservation, then easterly along the Navajo Indian Reservation boundary line to a point where it intersects the Navajo/Apache County Line); Pinal County (north of the line, "First Standard Parallel South" and east of the line "Second Guide Meridian East")

Area 4: Maricopa and Mohave Counties; Pinal County (north and west of the boundary line beginning at a point where the Papago Indian Reservation Road #15 crosses the Pima/Pinal County Line, then extending in a northeasterly direction on the Papago Indian Reservation Road #15 to the intersection with the Florence Canal, north and east on the Florence Canal to the intersection with the line, "Second Guide Meridian East", then north to the Pinal/Maricopa County Line); Yavapai County

Area 5: Cochise, Graham, Greenlee, and Pima Counties; Pinal County (south and east of the boundary line beginning at a point where the Papago Indian Reservation Road #15 crosses the Pima/Pinal County Line, then extending in a northeasterly direction on the Florence Canal, north and east on the Florence Canal to the intersection with the line, "Second Guide Meridian East", then north to the line, "First Standard Parallel South", and along that line to the Graham/Pinal County Line); Santa Cruz, Yuma, and La Paz Counties

IRONWORKERS:

Northern Area: The boundaries of the area shall be the Navajo & Hopi Indian reservations, the City of Page & the Glen Cayon Dam

Southern Area: Cochise, Graham, Pima, Santa Cruz, Yuma & Greenlee Cos. & those portions of Pinal & Gila Cos. located south of the 33rd parallel

Central Area: All parts of Arizona not in the Northern or Southern Areas

LINE CONSTRUCTION:

Zone 1: Phoenix and Tucson 30 miles radius from the center of Town; Area within 10 mile radius from the City Hall in Yuma

Zone 1-A: Flagstaff, Globe, and Kingman; and 10 mile radius from the center of Town

Zone 2: Other areas not covered by Zone 1 and Zone 1-A

PAINTERS:

Area 1: Apache, Coconino, Navajo, and Yavapai Counties (north of Woodruff/Camp Wood Line); Mohave County (north of a line following the Geodetic Hualapai Boundary Line to the Colorado River, a distance of 23 miles east of Pierce Ferry and then intersecting the Arizona/Nevada State Line):

- Zone A: 0-20 road miles from Courthouse in Flagstaff
- Zone B: 20-35 road miles from Courthouse in Flagstaff
- Zone C: 35-80 road miles from Courthouse in Flagstaff
- Zone D: 80 road miles and over from Courthouse in Flagstaff

Area 2: Apache, Coconino, Navajo, and Yavapai Counties (south of the Woodruff/Camp Wood Line); Gila, Graham, Greenlee, Maricopa, and Pinal Counties (north of 33rd Parallel); Mohave County (south of a

line following the Geodetic Hualapai Boundary Line to the Colorado River, a distance of 23 miles east of Pierce Ferry and then intersecting the Arizona/Nevada State Line):

Zone A: 0-40 paved road miles from Courthouse in Phoenix; also, Luke and Williams Air Force Bases
Zone B: 41-60 paved road miles from Courthouse in Phoenix
Zone C: 61 paved road miles and over from Courthouse in Phoenix

Area 3: Cochise County; Graham, Greenlee, Maricopa and Pinal Counties (south of 33rd Parallel); Pima, Santa Cruz, Yuma, and La Paz Counties:

Zone A: 0-30 paved road miles from Stone and Congress in Tucson or from the County Courthouse in Yuma
Zone B: 31-40 paved road miles from Stone and Congress in Tucson or from the County Courthouse in Yuma
Zone C: 41-50 paved road miles from Stone and Congress in Tucson or from the County Courthouse in Yuma
Zone D: 51 paved road miles and over from Stone and Congress in Tucson or from the County Courthouse in Yuma

PLUMBERS & PIPEFITTERS

ZONE 1

Base points shall be: Phoenix--the intersection of Central Avenue and Jefferson Street; Flagstaff, Yuma, Kingman, Prescott, Havasu City and Winslow -- the main Post Office building in each city. The "Free Zone" (Zone No. 1) from Phoenix shall be 40 miles from the stated base point. The Free Zone from Flagstaff, Yuma, Kingman, Prescott, Havasu City and Winslow shall be 20 road miles from the stated base point. In addition, all areas within the city limits of Phoenix, Chandler, Scottsdale, Tempe, Glendale, Mesa and Gilbert, as well as that area bordered or encompassed by Apache Trail on the north, Higley Road on the east, Elliott Road on the south and Arizona Avenue on the west, and Sun City West will be included as Free Zones. Any work contracted for outside of these Free Zones will be determined from the Phoenix base point.

ZONE 2

Pay Zone shall refer to all jobs outside of the Free Zones listed above.

ZONE 3

Seven Southern Counties of Arizona: Pima, Gila, Pinal, Graham, Greenlee, Santa Cruz, and Cochise

LABORERS:

Area 1: Area north of a straight line drawn between a point 35 miles due north of the City Hall in Flagstaff and a point 35 miles due north of the City Hall in Kingman, extending to the Arizona/Nevada State Line on the west; and connecting to a point 35 miles due north of the City Hall in Holbrook, thence due east to the intersection of Arizona/New Mexico State Line
Area 2: All Areas not included in Area 1

GROUP DESCRIPTIONS

LABORERS

Group 1: Laborer, General or Construction; Tool Dispatcher or Checker; Manually Controlled Signal Operator; Fence Builder; Guard Rail Builder - highway; Chat Box Man; Dumpman and/or Spotter; Rip Rap Stone Man; Rock Slinger; Head Rock Slinger ($.25); Form Stripper; Packing Rod Steel and Form Stripper; Packing Rod Steel and Pans; Cesspool Diggers and Installers; Astro Turf Layer; Clean Up - Bull Gang Trackman; Railroad Chipper (clearing and grubbing); Kettleman - Tarman; Spikers; Wrenchers - Creosote Tieman; Floor Sanders - Concrete; Sandblaster (Pot Tender); Powderman Tender; Fine Grader; All Tenders not herein separately classified; Window Cleaner Flaggers

Group 2: Concrete Laborer (belt, pipe and/or Hoseman); Cement Mason Tender; Cutting Torch Operator; Power-type Concrete Buggy; Bander

Group 3: Chuck Tender (except tunnel); Guinnea/Chaser; Operator and Tender of Pneumatic and Electric Tools; Concrete Vibrating Machines, Chain Saw Machines (on clearing and grubbing); Hydraulic Jacks and similar mechanical tools not separately herein classified; Pipe Caulker and/or Backup Man - Pipeline; Rigger and Signal Man - Pipeline; Pipe Wrapper; Cribber; Shorer (except tunnel); Pneumatic Gopher; Pre-cast, Manhole Erector

Group 4: Asphalt Raker and Ironer; Air and Water Washout Nozzleman (low and high pressure); Scaler (using Bos n's Chair or Safety Belt); Tamper (mechanical - all types); Sandblaster (Nozzleman); Concrete Saw (hand-guided); Concrete Cutting Torch; Gunite (Gunman, Mixerman, Rodman); bio-filter; Pressman; Installer; Operator; Hand-guided Trencher and similarly operated equipment; Driller (Jackhammer and/or Pavement Breaker); Grade Setter (pipeline); Pipe Layer (including but not limited to non-metallic transite and plastic pipe, water pipe, sewer pipe, drain pipe, underground tile and conduit)

Group 5: Drill Doctor and/or Air Tool Repairman; Scaler (Driller); Form Setter and/or Builder; Welder and/or Pipe Layer installing process piping; Driller - Core Diamond, Wagon, Air Track, Joy, Mustang, PR-143, 220 Gardner, Denver, Hydrasonic; Powder Man; Water Blaster Operator

(TUNNEL and SHAFT WORK)

Group 1: Bull Gang, Muckers, Trackman; Dumpmen; Concrete Crew (includes Rodders and Spreaders); Grout Crew; Swamper (Brakeman and Switchmen on tunnel work)

Group 2: Nipper; Chucktender, Cabletender; Vibratorman, Jackhammer, Pneumatic Tools (except Driller)

Group 3: Grout Gunman

Group 4: Timberman, Retimberman - wood or steel blaster, Driller, Powderman; Cherry Pickerman; Powderman - Primer House; Steel Form

Raiser and Setter; Kemper and other Pneumatic Concrete Placer Operator; Miner - Finisher; Miners - Tunnel (hand or machine)

Group 5: Diamond Drill

Group 5A: Shaft and Raise Miner Welder

POWER EQUIPMENT OPERATORS

Group 1: A Frame Boom Truck, Winch Truck, Air Compressor Operator, Beltorete Operator, Boring Bridge and Texture, Concrete Mixer Operator (skip type), Conductor, Brakeman, Handler, Conveyor Operator, Cross Timing and Pipe Float, Curing Machine Operator, Dinky Operator (under 20 tons), Elevator Hoist Operator (husky and similar), Firemen (all), Foorklift and Ross carrier Operator, Generator operator (all), Highline Cableway Signalman, Hydrographic Mulcher, Hydrographic seeder, Joint Inserter, Jumbo Finishing Machine, Kolman Belt Loader Operator, Machine Conveyor Operator, Multiple Power Concrete Saw Operator, Oiler, Pavement Breaker, Power Grizzly Operator, Power Sweeper, Pressure Grout Machine Operator (as used in heavy engineering construction), Pump Operator, Roller Operator (except as otherwise classified), Self-Propelled Chip Spreading Machine, Skiploader (3-1/2 c.y. and less), Slurry Seal Machine Operator (moto paver driver), Small Self-Propelled Compactor (with blade) - backfill, ditch operation, Straw Blower, Tractor Operator (D-5 and under), Tripper Operator, Tugger Operator, Welding Machine Operator, Wheel-Type Tractor Operator (Ford, Ferguson type with attachments, BeeGee etc.)

Group 2: Aggregate Plant Operator (including crushing, screening and sand plants, etc.), Asphalt Plant Mixer Operator, Asphalt Laydown Machine Operator, Backhoe Operator (rubber tire or track less than 1 c.y. MRC), Boring machine Operator, Concrete Batch Plant Operator (all types and sizes), Concrete Mechanical Tamping, Spreading or Finishing Machine Operator (including Clary, Johnson or similar types), Concrete Mixer Operator (paving type and mobile mixers), Concrete Pump Operator, Crane Operator (crawler and pneumatic less than 15 ton capacity MRC), Drilling Machine Operator (including water wells), Elevating Grader Operator (all types and sizes, except as otherwise classified), Field Equipment Serviceman, Grade Checker (excluding Civil Engineer), Locomotive Engineer (including Dinky 20 tons weight and over), Moto-Paver (and simmmilar type equipment) Operator, Motor Grader Operator (any type power blade-rough), Oiler Driver, Operating Engineer Rigger, Pneumatio Tired Scraper Operator (all sizes and types), Power Jumbo Form Setter Operator, Road Oil Mixing Machine Operator, Roller Operator (on all types asphalt pavement), Screed Operator, Self-Propelled Compactor (with blade) (815, 825 or equivalent - grade operation), Skip Loader Operator (all types with a rated capacity over 3 1/2 but less than 6 c.y.), Slip Form Operator (power driven lifting device for concrete forms), Soil Cement Road Mixing Machine Operator (single Pass type), Stationary Pipe-Wrapping and Cleaning Machine Operator, Surface Heater and Planer Operator Tractor Operator (dozer, pusher - all), Traveling Pipe-Wrapping Machine Operator, Trenching Machine Operator, Tugger (two or more)

Group 3: 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 Pump Operator (truck mounted, with boom attached), Crane Operator (crawler and pneumatic over 15 tons and less than 100 ton capacity MRC), Crawler-Type Tractor Operator (with boom attachment and slope bar), Derrick Operator, Gradall Operator, Heavy Duty Mechanic/Welder, Helicopter Hoist Operator or Pilot, Highline Cableway Operator, Mass Excavator Operator (150 Bucyrus, Erie and similar type), Mechanical Hoist Operator (two or more drums), Motor Grader Operator (any type power blade-finish), Mucking Machine Operator, Operating Engineers Electrician (including lineman, tower erector, cable splicer, etc.), Overhead Crane Operator, Piledriver Engineer (portable stationary or skid rig), Power Driver Ditch Lining or Ditch Trimming Machine Operator, Remote Control Earth Moving Machine Operator Skip Loader Operator (all types with rated capacity 6 c.y. but less than 10 c.y.), Slip Form Paving Machine Operator (including Gunnert, Zimmerman and similar types), Tower Crane (or similar type), Universal Equipment Operator (shovel, backhoe, dragline, clamshell, etc., up to 10 c.y.),

Group 4: Crane Operator (pneumatic or crawler - 100 ton hoisting capacity and over MRC rating), Skip Loader Operator (all types with rated capicity of 10 c.y. or more), Universal Equipment Operator (shovel, backhoe, dragline, clamshell, etc., 10 c.y. and over)

TRUCK DRIVERS

Group 1: Pickup Driver, Station Wagon Driver, Man Haul Driver, 4 axle or less Dump or Flattrack Driver, Self-propelled street sweeper, tireman, Water Truck Driver, 3800 Gals. and under, Vacuum Pump Truck Driver, Forklift or Fork Truck, Transit Mix Driver, 8 cy or less Mixer capacity, Ambulance Driver with current Red Cross or Bureau/Mines First Aid Certificate

Group 2: Transit Mix Driver, over 87 cy, Rock Truck Driver-under 35 tons, Oil Tanker or Spreader Truck Driver and/or Bootman, Retortman or Leverman, 5 axle Dump or Flattrack Driver, Water Truck Driver 3900 gal and over, Off-Highway Equipment Driver including but not limited to: 2 or 4 Wheel Power Unit, i.e., Cat DW Series, Euclid, Int'l and Similar Type Equipment, Transporting Material when top loaded or by External Means, Including Pulling Water Tanks, Fuel Tanks or other applications under Teamster Classification

Group 3: Field Equipment Serviceman or Fuel Truck Driver, Heavy Duty Mechanic/Welder, Transport Driver (Heavy Equipment), Off Highway Rock Truck-35 Tons and over

Combination men shall be paid thirty cents ($.30) over the highest rated work.

Unlisted classificatipns 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))

Reference: DACW09-90-B-0029

SPECIFICATIONS

for

ARIZONA CANAL DIVERSION CHANNEL

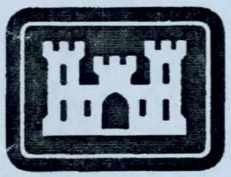
(Cudia City Wash To Dreamy Draw, Including Cudia City Wash Sediment Basin)

Maricopa County, Arizona

Authority: Public Law 89–298, Flood Control Act of 1965

Appropriation: 96x3122 Construction General Corps of Engineers, Civil

96x8862 Contributed Funds, Other



US Army Corps of Engineers

Los Angeles District

SPECIAL CLAUSES

Index

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 810 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.

1.1 Completion of Channel Improvement and Appurtenant Work. Subject to the provisions of of the paragraph entitled "Public Utilities, Notices, and Restrictions," of SECTION: GENERAL REQUIREMENTS, the Contractor shall complete pertinent parts of the entire work as specified below:

1.1.1 Channel Construction at Arizona Biltmore Hotel. The Contractor shall complete all work at the Arizona Biltmore Hotel between Sta. 935+30 and Sta. 920+30 ready for flood control use, including final grading, not later than September 10, 1991. The Contractor will not be permitted to begin construction operations, within the limits specified herein, until May 28, 1991.

1.1.2 Stanford Drive. The Contractor shall complete the covered channel at Stanford Drive between Sta. 975+51.70 and Sta. 963+49 not later than 300 Calendar days after the date on which construction of the covered channel is started. Starting of the channel is defined as the date that the existing road crossing is closed to through traffic. The time stated shall include completion of the road crossing and the reopening of the street to normal traffic. Covered channel construction shall be coordinated with the traffic rerouting details and staging indicated on the drawings and the subparagragh entitled "Traffic Routing" of SECTION: GENERAL REQUIREMENTS.

1.1.3 24th Street. The Contractor shall complete the covered channel at 24th Street between Sta. 904+00 and Sta. 897+00 not later than 270 Calendar days after the date on which construction of the covered channel is started. Starting of the channel is defined as the date that the existing road crossing is closed to through traffic.

The time stated shall include completion of the road crossing and the reopening of the street to normal traffic. Covered channel construction shall be coordinated with the traffic rerouting details and staging indicated on the drawings and the subparagragh entitled "Traffic Routing" of SECTION: GENERAL REQUIREMENTS.

1.1.4 35th Street Side Drain. The Contractor shall complete construction of the 35th Street side drain not later than 100 Calendar days after the date on which construction of the side drain is started. Starting of the side drain is defined as the date that the covered channel is completed and ready for flood control use including required preparation for the connection of the side drain.

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

2.1 If the Contractor fails to complete the work within the time(s) specified in the contract, or any extensions, the Contractor shall pay to the Government as liquidated damages, the following sums separately for each day of delay.

2.1.1 Completion of Channel Construction at Arizona Biltmore Hotel as specified in subparagraph 1.1.1; $5,000.00.

2.1.2 Completion of Stanford Drive as specified in subparagraph 1.1.2; $350.00.

2.1.3 Completion of 24th Street as specified in subparagraph 1.1.3; $350.00.

2.1.4 Completion of 35th Street Side Drain as specified in subparagraph 1.1.4; $350.00.

2.1.5 Completion of remaining work including clean-up; $350.00.

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, MAPS 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 reproducibles 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:

Title	File and Drawing No.
Index to Contract Drawings	252/840

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 (May 15, 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 (28 Mar 1986) DTL 1110-1-4. Within 15 days after receipt of Notice to Proceed, the Contractor shall complete and submit to the Contracting Officer, in duplicate, a Submittal Register (ENG Form 4288) listing all submittals required under the Contract (including the Contract Clauses, the Special Clauses, and the Technical Provisions) and dates of submittals. In addition to those items listed on ENG Form 4288, the Contractor shall furnish submittals for any proposed deviations from the plans or specifications. The scheduled need dates shall 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 Register at least every 30 days and take appropriate action to maintain an effective system. Copies of updated or corrected Registers 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.

4.2.1 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 Special Clauses shall govern.

4.2.2 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.

4.3 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.

4.4 Shop Drawings. The Contractor shall submit to the Contracting Officer for approval 6 copies of all shop drawings called for by these specifications. One set will be returned to the Contractor.

4.5 Certificates of Compliance. Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in 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.

4.6 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 and auger borings.

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. SALVAGE MATERIALS AND EQUIPMENT (JAN 1965) DFARS 252.236-7005. The Contractor shall maintain adequate property control records for all materials or equipment specified to be salvaged. These records may be in accordance with the Contractor's system of property control, if approved by the property administrator. The Contractor shall be responsible for the adequate storage and protection of all salvaged materials and equipment and shall replace, at no cost to the Government, all salvaged materials and equipment which are broken or damaged during salvage operations as the result of his negligence, or while in his care.

8. QUANTITY SURVEYS (APR 1984) FAR 52.236-16.

8.1 Quantity surveys shall be conducted, and the data derived from these surveys shall be used in computing the quantities of work performed and the actual construction completed and in place.

8.2 The Government shall conduct the original and final surveys and make the computations based on them. The Contractor shall conduct the surveys for any periods for which progress payments are requested and shall make the computations based on these surveys. All surveys conducted by the Contractor shall be conducted under the direction of a representative of the Contracting Officer, unless the Contracting Officer waives this requirement in a specific instance.

8.3 Promptly upon completing a survey, the Contractor shall furnish the originals of all field notes and all other records relating to the survey or to the layout of the work to the Contracting Officer, who shall use them as necessary to determine the amount of progress payments. The Contractor shall retain copies of all such material furnished to the Contracting Officer.

9. TIME EXTENSIONS (APR 1984) FAR 52.212-6.

9.1 Notwithstanding any other provisions of this contract, it is mutually understood that the time extensions for changes in the work will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the contract completion date will be extended only for those specific elements so delayed

and that the remaining contract completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages under the new completion schedule.

10. CONTINUING CONTRACTS (1985 JAN HQ USACE) EFARS 52.232-10001.

10.1 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 CONTRACT CLAUSE: PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS or any other clause of this contract.

10.2 Amount.

10.2.1 The sum of $10,000.00 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.

10.2.2 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 10.6, 10.7, 10.8, and 10.9] below. No such failure shall constitute a breach of this contract, except that this provision shall not bar a breach-of-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.

10.3 Additional Funds.

10.3.1 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.

10.3.2 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.

10.4 Exhaustion of Funds.

10.4.1 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.

10.4.2 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.

10.4.3 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.

10.5 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.

10.6 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.

11. IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY (APR 1984) FAR 52.245-3.

11.1 The Government will furnish to the Contractor the property identified in the Schedule to be incorporated or installed into the work or used in performing the contract. The listed property will be furnished f.o.b. railroad cars at the place specified in the contract Schedule or f.o.b. truck at the project site. The Contractor is required to accept delivery, pay any demurrage or detention charges, and unload and transport the property to the job site at its own expense. When the property is delivered, the Contractor shall verify its quantity and condition and acknowledge receipt in writing to the Contracting Officer. The Contractor shall also report in writing to the Contracting Officer within 24 hours of delivery any damage to or shortage of the property as received. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated in this contract.

11.2 Each item of property to be furnished under this clause is identified in the following Schedule by quantity, item, and description. The estimated value of Government furnished property under this contract is expected to be over $10,000.00.

SCHEDULE

Quantity	Item	Description
4	Survey Monuments	3" Bronze Disk (f.o.b. job site)
10	Box Beams	Precast, Prestressed Concrete Box Beams (f.o.b. 35th Ave and Pinnacle Peak Road)

12. PROPERTY RECORDS (APR 1984) FAR 52.245-1. The Government shall maintain the Government's official property records in connection with Government property under this contract. The Government Property clause is hereby modified by deleting the requirement for the Contractor to maintain such records.

13. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (1989 JUL) EFARS 31.105.

13.1 Allowable cost for construction and marine plant and 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. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

13.2 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.

13.3 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.

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

14.1 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.

15. AS-BUILT DRAWINGS (30 JUL 1986) ER 415-345-38.

15.1 General. The Contractor shall furnish 3 full size sets of as-built blueline 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:

(a) 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.

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

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

(d) Correct elevations if changes were made in site grading.

(e) 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.

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

(g) All changes or modifications which result from the final inspection.

15.2 Options. Where contract drawings or specifications allow options, only the option selected for construction shall be shown on the as-built drawings.

15.3 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 3 full size sets of blueline 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.

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

16.1 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
Precipitn .10"	2	2	2	1	0	0	2	3	2	2	1	2
Temp 32^{0}F	8	5	1	0	0	0	0	0	0	0	2	6
Total days*	10	7	3	1	0	0	2	3	2	2	3	8

*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 a summer thunderstorms can exceed 45 mph on relatively rare occasions.

The site can experience light snowfall on rare occasions between late November and early March.

16.2 Determination.

16.2.1 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 16.1 above. For purposes of subparagraph 16.2, the term actual adverse weather days shall include days impacted by actual adverse weather days.

16.2.2 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 16.1 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 Officer will convert any delays to meeting the above requirements to calendar days and issue a modification in accordance with the CONTRACT CLAUSE: DEFAULT.

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

17. BASIS FOR SETTLEMENT OF PROPOSALS (JUL 1989) EFARS 49.113(100). Actual costs will be used to determine equipment costs for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a termination settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

17.1 Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the Contractor's accounting records to determine total actual equipment costs.

17.2 If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

17.3 Recorded job costs adjusted for unallowable and unallocable expenses will be used to determine equipment operating expense.

17.4 Ownership costs (depreciation) will be determined using the Contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

17.5 License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the Contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

18. CONTRACTOR-PREPARED NETWORK ANALYSIS SYSTEM (APR 1968) DFARS 252.236-7012. The progress chart to be prepared by the Contractor pursuant to the clause entitled "Schedules for Construction Contracts", shall consist of a network analysis system as described below. In preparing this system the scheduling of construction is the responsibility of the Contractor. The requirement for the system is included to assure adequate planning and execution of the work and to assist the Contracting Officer in appraising the reasonableness of the proposed schedule and evaluating progress of the work.

18.1 An example of one of the numerous acceptable types of network analysis systems is shown in Appendix I of Corps of Engineers Regulation ER 1-1-11 entitled "Network Analysis System", single copies of which are available to bona fide bidders on request. Other systems which are designed to serve the same purpose and employ the same basic principles as are illustrated in Appendix I will be accepted subject to the approval of the Contracting Officer.

18.2 The system shall consist of diagrams and accompanying mathematical analyses. The diagrams shall show elements of the project in detail and the entire project in summary.

18.2.1 Diagrams shall show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by the Contractor. The basic concept of a network analysis diagram will be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of following activities.

18.2.2 Detailed network activities shown on a detailed or subnetwork diagram shall include, in addition to construction activities, the submittal and approval of samples of materials and shop drawings, the procurement of critical materials and equipment,

fabrication of special material and equipment and their installation and testing. All activities of the Government that affect progress and contract required dates for completion of all or parts of the work will be shown. The detail of information shall be such that duration times of activities will range from three (3) to thirty (30) days with not over two percent (2%) of the activities exceeding these limits. The activities which comprise the following features shall be separately identifiable by coding or use of subnetworks or both:

Channel Construction at Arizona Biltmore Hotel
Stanford Drive
24th Street
35th Street Side Drain

The selection and number of activities shall be subject to the Contracting Officer's approval. Detailed networks, when summary networks are also furnished, need not be time scaled but shall be drafted to show a continuous flow from left to right with no arrows from right to left. The following information shall be shown on the diagrams for each activity: preceding and following event numbers, description of the activity, cost, and activity duration.

18.2.3 Summary Network. If the project is of such size that the entire network cannot be readily shown on a single sheet, a summary network diagram shall be provided. The summary network diagram shall consist of a minimum of fifty activities and a maximum of one hundred and fifty activities, and shall be based on and supported by detailed diagrams. Related activities shall be grouped on the network. The critical path shall be plotted generally along the center of the sheet with channels with increasing float placed towards the top or bottom. The summary network shall be time scaled using units of approximately one-half inch equals one week or other suitable scale approved by the Contracting Officer. Weekends and holidays shall be indicated. Where slack exists, the activities shall be shown at the time when they are scheduled to be accomplished.

18.2.4 The mathematical analysis of the network diagram shall include a tabulation of each activity shown on the detailed network diagrams. The following information will be furnished as a minimum for each activity:

(i) preceding and following event numbers (numbers shall be selected and assigned so as to permit identification of the activities with bid items);
(ii) activity description;
(iii) estimated duration of activities (the best estimate available at time of computation);
(iv) earliest start date (by calendar date);
(v) earliest finish date (by calendar date);
(vi) scheduled or actual start date (by calendar date);
(vii) scheduled or actual finish date (by calendar date);
(viii) latest start date (by calendar date);
(ix) latest finish date (by calendar date);
(x) slack or float;
(xi) monetary value of activity;
(xii) responsibility for activity (Prime contractor, subcontractors, suppliers, Government, etc.);
(xiii) manpower required;

(xiv) percentage of activity completed;
(xv) contractor's earnings based on portion of activity completed; and
(xvi) bid item of which activity is a part.

18.2.5 The program or means used in making the mathematical computation shall be capable of compiling the total value of completed and partially completed activities and subtotals from separate buildings or feature listed in paragraph 18.2.2.

18.2.6 In addition to the tabulation of activities, the computation will include the following data:

(i) identification of activities which are planned to be expedited by use of overtime or double shifts to be worked including Saturdays, Sundays, and holidays;
(ii) on-site manpower loading schedule;
(iii) a description of the major items of construction equipment planned for operations of the project. (The description shall include the type, number of units and unit capacities. A schedule showing proposed time equipment will be on the job keyed to activities on which equipment will be used shall be provided); and
(iv) where portions of the work are to be paid by unit costs, the estimated number of units in an activity which was used in developing the total activity cost.

18.2.7 The analysis shall list the activities in sorts or groups as follows:

(i) by the preceding event number from lowest to highest and then in the order of the following event number;
(ii) by the amount of slack, then in order of preceding event number;
(iii) by responsibility in order of earliest allowable start dates; and
(iv) in order of latest allowable start dates, then in order of preceding event numbers, and then in order of succeeding event numbers.

18.3 Submission and approval of the system shall be as follows:

18.3.1 A preliminary network defining the Contractor's planned operations during the first sixty (60) calendar days after notice to proceed will be submitted within ten (10) days. The Contractor's general approach for the balance of the project shall be indicated. Cost of activities expected to be completed or partially completed before submission and approval of the whole schedule should be included.

18.3.2 The complete network analysis consisting of the detailed network mathematical analysis (on-site manpower loading schedule, equipment schedule) and network diagrams shall be submitted within forty (40) calendar days after receipt of notice to proceed.

18.4 The Contractor shall participate in a review and evaluation of the proposed network diagrams and analysis by the Contracting Officer. Any revisions necessary as a result of this review shall be resubmitted for approval of the Contracting Officer within ten (10) calendar days after the conference. The approved schedule shall then be the schedule to be used by the Contractor for planning, organizing and directing the work and for reporting progress. If the Contractor thereafter desires to make changes in his method of operating and scheduling he shall notify the Contracting Officer in writing stating the reasons for the change. If the Contracting Officer considers these changes to be of a major nature he may require the Contractor to revise and submit for approval, without additional cost to the Government, all or

the affected portion of the detailed diagrams and mathematical analysis and the summary diagram to show the effect on the entire project. A change may be considered of a major nature if the time estimated to be required or actually used for an activity or the logic of sequence of activities is varied from the original plan to a degree that there is a reasonable doubt as to the effect on the contract completion date or dates. Changes which affect activities with adequate slack time shall be considered as minor changes, except that an accumulation of minor changes may be considered a major change when their cumulative effect might affect the contract completion date.

18.5 The Contractor shall submit at intervals of fifteen (15) calendar days a report of the actual construction progress by updating the mathematical analyses. Revisions causing changes in the detailed network shall be noted on the summary network, or a revised issue of affected portions of the detailed network finished. The summary network shall be revised as necessary for the sake of clarity. However, only the initial submission or complete revisions need be time scaled. Subsequent minor revisions need not be time scaled.

18.6 The report shall show the activities or portions of activities completed during the reporting period and their total value as basis for the Contractor's periodic request for payment. Payment made pursuant to the General Provision entitled "Payments to Contractor" will be based on the total value of such activities completed or partially completed after verification by the Contracting Officer. The report will state the percentage of the work actually completed and scheduled as of the report date and the progress along the critical path in terms of days ahead or behind the allowable dates. If the project is behind schedule, progress along other paths with negative slack shall also be reported. The Contractor shall also submit a narrative report with the updated analysis which shall include but not be limited to a description of the problem areas, current and anticipated, delaying factors and their impact, and an explanation of corrective actions taken or proposed.

18.7 Sheet size of diagrams shall be 30 by 42 inches. Each updated copy shall show a date of the latest revision.

18.8 Initial submittal and complete revisions shall be submitted in six (6) copies.

(i) Periodic reports shall be submitted in four (4) copies.

* * * * *

Arizona Canal Diversion Channel, Cudia City Wash to Dreamy Draw including

SUBMITTAL REGISTER *(ER 415-1-10)*

TITLE AND LOCATION: Cudia City Wash Basin, Maricopa County, Arizona

CONTRACTOR

CONTRACT NUMBER

NAS ACTIVITY CODE I J	SUBMITTAL IDENTIFICATION (ITEM NUMBER)	SPECIFICATION PARAGRAPH NUMBER	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL: SHOP DRAWING	SAMPLE	GUARANTEE	MFR'S DATA	CERTIFICATE	TEST REPORT	OTHER, AS NOTED	ACTION ELEMENT: *TECH REVIEW BY	CONTRACTOR SCHEDULED DATES: SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CORPS ACTION DATES: SUBMITTED TO CORPS	ACTION CODE	REMARKS
			SPECIAL CLAUSES														
		4.2	Submittal Register							X	RE						
		15.1	Material Safety Data Sheet							X	RE						
		SECTION 1A,	GENERAL REQUIREMENTS														
		9.5.7.6.1	Haul Routes							X	RE						
		SECTION 1C,	CONTRACTOR'S QUALITY CONTROL														
		2.1	Contractor Quality Control Plan							X	RE						
		3.1	System Manager's Qualifications							X	RE						
		3.2	Personnel Qualifications							X	RE						
		SECTION 1D,	ENVIRONMENTAL PROTECTION														
		3.	Environmental Protection Plan							X	RE						
		SECTION 1E,	DETOURS, STREET RECONSTRUCTION AND TRAFFIC CONTROL FACILITIES														
		1.	Detour Plans	X							RE						
		SECTION 2A,	DIVERSION AND CONTROL OF WATER														
		1.1	Method of Dewatering							X	RE						
		SECTION 2C,	EXCAVATION														
		3.2	Safety Plan							X	RE						
		3.5.1	Blasting Plan							X	RE-ED						

*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

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	ACTION CODE	
		3.5.2	Pre-Blast Inspection Report							X	RE-ED						
		3.7	Personnel Qualification							X	RE						
		3.10	Blasting Records							X	RE-ED						
		4.	Method of Shoring and Bracing	X							RE-ED						
		SECTION 2D,	FILLS AND SUBGRADE PREPARATION														
		3.1	Moisture Density							X	RE						
		3.1	Field Density							X	RE						
		3.2	Gradation							X	RE						
		SECTION 2E,	PRIME COAT AND WEED KILLER														
		3.1	Bituminous Materials	X							RE						
		3.3	Bituminous Material Test Reports						X		RE						
		4.	Prime Coat					X			RE						
		7.	Surface Preparation							X	RE						
		8.	Weed Killer, Application Methods,														
			and Rates				X			X	RE						
		10.	Weigh Bills or Delivery Tickets							X	RE						
		SECTION 2F,	ASPHALT CONCRETE														
		5.1	Bituminous Materials		X						RE						

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

GPO : 1984 O - 458-677

SUBMITTAL REGISTER (ER 415-1-10)	TITLE AND LOCATION	CONTRACT NUMBER
	CONTRACTOR	

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	ACTION CODE	
		5.2	Bituminous Material Testing					X			RE						
		7.1	Job-Mix Formula							X	RE						
		14.1	Quantities							X	RE						
		14.4	Surface Preparation							X	RE						
		17.1	New Mix Design for Overlay							X	RE						
		19.	Weigh Bills or Delivery Tickets							X	RE						
		SECTION 2G,	AGGREGATE BASE														
		3.1	Aggregate From Source		X						RE						
		3.3	Aggregate from Source						X		RE						
		3.4	Approval of Materials						X	X	RE						
		7.	Subgrade Preparation							X	RE						
		16.	Weigh Bills or Delivery Tickets							X	RE						
		16.	Quality Control Report						X		RE						
		SECTION 2H,	MISCELLANEOUS AGGREGATES														
		2.6	Desert Gravel		X						RE-ED						
		SECTION 2I,	TREES, SHRUBS, AND GROUND COVERS														
		2.1	Plant Materials							X	RE-ED						
		3.1a	Top Soil		X		X		X		RE-ED						

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

GPO : 1984 O - 458-677

SUBMITTAL REGISTER *(ER 415-1-10)* | TITLE AND LOCATION | 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	ACTION CODE	
		3.1b	Soil Amendments		X		X		X		RE-ED						
		3.1c	Erosion Control Material		X						RE-ED						
		3.4	Maintenance Instructions							X	RE-ED						
		4.1.5	Soil Conditioners and Amendments				X	X			RE-ED						
		4.2.2	Storage of Other Materials							X	RE						
		SECTION 2J,	IRRIGATION														
		11.	Automatic Controller, Enclosure														
			and Compartments			X		X			RE-ED						
		11.	Backflow Prevention Units			X		X			RE-ED						
		11.	Control Valves			X		X			RE-ED						
		11.	Emitters and Drip Lines			X		X			RE-ED						
		11.	Fertilizers Injector Unit			X		X			RE-ED						
		11.	Flow Sensor			X		X			RE-ED						
		11.	Filter Units			X		X			RE-ED						
		11.	Flush Valves			X		X			RE-ED						
		11.	Gate Valves			X		X			RE-ED						
		11.	Ball Valves			X		X			RE-ED						
		11.	Pressure Sensor			X		X			RE-ED						

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		11.	Pressure Regulator			X		X			RE-ED						
		11.	PVC Pipe and Fittings			X		X			RE-ED						
		11.	Quick Coupling Valves and Keys			X		X			RE-ED						
		11.	Tensiometers			X		X			RE-ED						
		11.	Water Meters			X		X			RE-ED						
		SECTION 2K,	CONCRETE SIDEWALKS, CURBS, GUTTERS AND DRIVEWAY ENTRANCES														
		2.	Concrete - Field Control Tests						X		RE						
		8.1.1	Concrete Installation Procedure							X	RE						
		SECTION 2L,	STONE PROTECTION														
		2.2	Stone		X						RE						
		2.3	Service Records							X	RE-ED						
		2.5	Gradation Test						X		RE-ED						
		3.1	Subgrade Inspection Certification						X	X	RE						
		5.	Weigh Bills or Delivery Tickets					X		X	RE						
		SECTION 2M,	SIDE DRAINS, GAGING STATION, MANHOLES AND MANHOLE ADJUSTMENTS														
		2.1	Installation Procedures							X	RE						
		3.	Certification						X		RE						
		10.2.1	Approval of Material						X	X	RE						

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		13.5.1	Moisture - Density						X		RE						
		13.5.2	Field Density						X		RE						
		SECTION 2N,	GROUTED STONE PROTECTION														
		6.	Test Panel							X	RE						
		SECTION 2P,	SUBDRAIN SYSTEM														
		2.1	Manufacturer's Recommendations							X	RE						
		2.2	Pipe Specifications						X		RE						
		4.1	Approval of Material						X	X	RE						
		6.3	Geotextile		X			X			RE						
		6.6	Installation of the Geotextile							X	RE						
		SECTION 2Q,	PAVEMENT MARKINGS														
		2.	Materials				X				RE						
		3.	Sampling and Testing		X				X		RE						
		SECTION 2S,	CONCRETE PAVING STONE														
		3.1	Materials					X			RE-ED						
		3.2	Test Reports						X		RE						
		SECTION 2U,	WATER LINES														
		1.4	Materials				X				RE						

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		1.4, 3.3	Disinfection					X	X		RE						
		1.4, 3.1.4.2	Manufacturer's Representative														
			Qualifications							X	RE						
		1.4	Installation					X			RE						
		SECTION 2V,	SANITARY SEWERS														
		1.5	Submittals				X				RE						
		1.5	Materials							X	RE						
		2.1	Pipe		X				X		RE						
		SECTION 3A,	FORMWORK FOR CONCRETE														
		2.1	Shop Drawings and Computations	X						X	RE						
		2.2	Manufacturer's Literature				X				RE						
		2.3	Sample Panels and Posts		X						RE						
		8.2	Supported Concrete						X		RE						
		9.	Field Quality Control						X		RE						
		SECTION 3B,	EXPANSION, CONTRACTION AND CONSTRUCTION JOINTS IN CONCRETE														
		2.1	Strips, Seals and Lubricant						X		RE						
		SECTION 3C,	STEEL BARS, STEEL WELDED WIRE FABRIC, AND ACCESSORIES FOR CONCRETE REINFORCEMENT														
		2.	Certification Testing					X	X		RE						

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		3.1(1)	Reinforced Steel Schedule	X							RE						
		3.1(2)	Bar Supports	X							RE						
		3.1(3)	Mark Designations	X							RE						
		3.2	Reinforcement Steel						X		RE						
		3.3	Disposition Records							X	RE						
		SECTION 3P,	CONCRETE														
		2.1.1	Aggregate		X						RE						
		2.1.2	Cementitious Material Sources							X	RE						
		4.1.1	Concrete Mixture Proportions						X	X	RE						
		4.1.2	Cement and Pozzolan				X	X	X		RE						
		4.1.3.1	Non-Shrink Grout				X	X		X	RE						
		4.1.3.2	Prepackaged Material						X		RE						
		4.1.3.3	Volume Change Controlling														
			Ingredient					X	X	X	RE						
		4.2.1	Accelerating Admixture					X			RE						
		4.2.2	Impervious Sheet Curing Material					X			RE						
		4.2.3	Air-Entraining Admixture					X			RE						
		4.2.4	Water Reducing Admixture					X			RE						

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		4.2.5	Color Admixture					X			RE						
		4.3.1	Batch Plant							X	RE						
		4.3.2	Mixers							X	RE						
		4.3.3	Conveying Equipment							X	RE						
		4.3.4	Placing							X	RE						
		4.3.5	Joint Clean-Up							X	RE						
		4.3.6	Curing							X	RE						
		4.3.7	Cold Weather Methods							X	RE						
		4.3.8	Hot Weather Methods							X	RE						
		9.2	Concrete on Earth Foundations					X		X	RE						
		14.2.1.1	Fine Aggregate Grading						X		RE						
		14.2.1.2	Fine Aggregate Moisture Content						X		RE						
		14.2.2.1	Coarse Aggregate Grading						X		RE						
		14.2.2.2	Coarse Aggregate Moisture Content						X		RE						
		14.2.3	Deleterious Substance						X		RE						
		14.2.4.1	Weighing Accuracy						X		RE						
		14.2.4.2	Batching and Recording Accuracy						X		RE						
		14.2.5	Batch Plant Control							X	RE						

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		14.2.6.1	Air Content						X		RE						
		14.2.6.2	Slump						X		RE						
		14.2.6.3	Batch Ticket							X	RE						
		14.2.7	Preparation for Placing							X	RE						
		14.2.8	Placing							X	RE						
		14.2.9	Vibrators						X		RE						
		14.2.12.1	Concrete Plant Mixer						X		RE						
		14.2.12.2	Truck Mixers						X		RE						
		14.3.5.2	Adjustment to Batch Weights							X	RE						
		14.3.5.3	Test Panel							X	RE						
		SECTION 3E,	PRECAST PRESTRESSED CONCRETE														
		5.1	Design Calculations							X	RE-ED						
		5.2	Material Tests						X		RE						
		5.3	Construction Tests						X		RE						
		5.4.1	Cement				X	X			RE						
		5.4.2	Pozzolan				X	X			RE						
		5.4.3	Water Reducing Admixture				X	X			RE						
		5.4.4	Aggregates				X	X			RE						

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		5.5	Concrete Mix Proportions							X	RE						
		5.6	Shop Drawings	X							RE-ED						
		7.2	Mix Design						X	X	RE						
		17.5.4	Erection Plan							X	RE						
		18.1	Quality Control							X	RE						
		SECTION 3F,	STRESSING TENDONS AND ACCESSORIES FOR PRESTRESSED CONCRETE														
		3.1	Shop Drawings	X							RE-ED						
		3.2	Materials Tests					X	X		RE						
		3.3	Disposition Records							X	RE						
		3.4	Equipment Descriptions					X	X	X	RE						
		3.5	Technician Certification					X			RE						
		3.6	Prestressing Records							X	RE						
		5.3	Anchorage and Couplers							X	RE						
		5.4	Shrinkage Compensating Admixture							X	RE						
		6.2	Stressing Tendons and Ducts							X	RE						
		6.3.2.2	Single-Stand Release Schedule							X	RE						
		6.3.3	Post-Tensioning (Temporary														
			Overstressing)							X	RE						

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		SECTION 3G,	SHOTCRETE														
		4.1.1	Cement and Pozzolan					X			RE						
		4.1.2	Aggregates						X		RE						
		4.2	Curing Materials and Sealant				X				RE						
		4.3	Mixture Proportions and test data						X	X	RE						
		4.4.2	Test Panel		X						RE						
		4.4.3	Operator Qualifications							X	RE						
		SECTION 3H,	PORTLAND CEMENT - STABILIZED BASE OR SUBBASE COURSE														
		1.6	Mix Designs						X	X	RE						
		1.6	Aggregate and Bituminous														
			Materials						X	X	RE						
		2.2.1	Laboratory Inspection							X	RE						
		3.10.6	Samples of Bituminous Materials							X	RE						
		SECTION 4A,	REINFORCED MASONRY														
		2.	Testing Agency							X	RE						
		3.	Sample Panels		X					X	RE						
		4.1(a)	Anchors and Ties		X						RE						
		4.1(b)	Concrete Masonry Units		X						RE						

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		4.1(c)	Joint Reinforcement		X						RE						
		4.1(d)	Aggregates		X						RE						
		4.2(a)	Concrete Masonry Units					X			RE						
		4.2(b)	Joint Reinforcement					X			RE						
		4.2(c)	Lime					X			RE						
		4.2(d)	Reinforcing Bars					X			RE						
		4.3	Concrete Masonry Units						X		RE						
		4.3	Cement						X		RE						
		4.4.1	Reinforcing Bars	X							RE						
		SECTION 5A,	MISCELLANEOUS METALS														
		2.1	Fabrication of Fence Panels,														
			Fence Posts, Pipe Gates,														
			Outlet Gates	X							RE						
		SECTION 11A,	MISCELLANEOUS ITEMS OF WORK														
		2.	Miscellaneous Items of Work	X							RE						
		SECTION 16A,	ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND														
		3.1	Materials and Equipments			X	X	X		X	RE-ED						
		3.2(a)	Service Entrance Section	X							RE-ED						

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		3.2(b)	Secondary Panel Boards	X							RE-ED						
		3.2(c)	Lighting Luminaires, Mounting														
			Brackets, Poles and Pole Base	X							RE-ED						
		3.2(d)	Hand Holes	X							RE-ED						
		3.2(e)	Cable	X	X		X		X		RE-ED						
		3.3	List of Equipment and Materials							X	RE-ED						
		3.4	Instruction Manuals							X	RE-ED						
		3.5	Manufacturer's Certifications					X	X		RE-ED						
		3.6	Field Test Report					X	X	X	RE-ED						

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TECHNICAL PROVISIONS

SECTION 1A

GENERAL REQUIREMENTS

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 Federal Specifications (FS).

FS FF-B-575	(Rev C) Bolts, Hexagon and Square
FS FF-N-105	(Rev B; Am 3, Int Am 4) Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
FS FF-N-836	(Rev B; Am 2) Nut, Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat
FS MM-L-751	(Rev H) Lumber; Softwood
FS TT-E-529	(Rev G) Enamel, Alkyd, Semi-Gloss
FS TT-P-25	(Rev E; 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 (DOC).

DOC PS 1	(1983) Construction and Industrial Plywood

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 Fifteen 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 Eighteen hard hat signs at locations directed.

2.2 Project Engineer's Office.

2.3 Bulletin Board at the Contractor's office.

2.4 Sanitary Facilities.

3. CONSTRUCTION SIGNS.

3.1 Materials.

3.1.1 Lumber shall conform to FS 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 DOC PS 1, grade A-C, Group 1, exterior type.

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

3.1.4 Paints and Oils. Paints shall conform to FS TT-P-25 for primer and FS 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 OFFICES. The Contractor shall provide the following office facilities for the project engineer:

4.1 Lease 24 X 60 Office Trailer. The existing 24 X 60 office trailer located at 9601 North 21st Drive, Phoenix, Arizona is presently being leased from WMI Services at a cost of $550.00 per month. The Contractor shall arrange to extend the lease from 19 November 1990 until the completion of work under this contract. Arrangements for extending the lease may be made by contacting WMI at (602) 437-1177, Mr. Terry Burt. The Contractor shall also be responsible for maintaining the existing utilities. The cost for sewer, water, and telephone usage will be the responsibility of the Government.

4.2 10 X 40 Office Trailer. The Contractor shall provide a suitable 10 X 40 office trailer at the above location. The trailer shall be adequately heated, well lighted, suitably ventilated, and cooled with a properly sized air conditioning unit. An adequate supply of cooled drinking water shall be supplied and maintained. Sewer, telephone, and electrical service shall be provided and maintained. The cost for sewer, water, and telephone usage will be the responsibility of the Government. Materials for the facilities need not be new provided they are adequate for the intended use. The Contractor may elect to make arrangements to purchase or lease the existing 10 X 40 office trailer presently in use.

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.

8.1 Town of Paradise Valley Sign. The Contractor shall remove the "Town of Paradise Valley" sign including two posts from the South side of Stanford Drive. The sign and posts shall be delivered to:

Mr. Gus Holka
Street Superintendent of Paradise Valley
6401 E. Lincoln Drive
Paradise Valley, Arizona 85253
Phone: (602)948-7411

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 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 under the CONTRACT CLAUSES of the contract.

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 for such damage 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 the clause of the contract: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS of the CONTRACT CLAUSES. 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 35th Street Wash Drainage Box Culvert. The existing utilities at 35th Street (Station 968+40) will be relocated or supported by others prior to construction of the box culvert. The Contractor shall notify the owners of the utilities as specified hereinafter not less than 60 calendar days prior to start of work on the box culvert.

10.4.2 36th Street Pedestrian Bridge. Final installation of underground utilities at 36th Street pedestrian bridge will be made by others prior to completion grading and paving. The Contractor shall notify the owners of the utilities as specified hereinafter not less than 60 calendar days prior to start of final grading and paving work.

10.4.3 Arizona Biltmore Hotel. The existing electrical lines at the Arizona Biltmore Hotel will be temporarily relocated or supported by others prior to construction of the box culvert. The Contractor shall notify the Salt River Project (SRP) as specified hereinafter not less than 30 calendar days prior to start of work in the

area. The Contractor shall construct the conduits for the final installation as indicated on the drawings. Final installation of the electrical service will be made by SRP.

10.4.4 City of Phoenix Presedimentation Basins. Construction of City of Phoenix presedimentation basins adjacent to work is expected to be in progress during the period October 1991 through September 1992. The Contractor shall cooperate and coordinate with COP for this work. The contact for COP will be as specified hereinbefore.

10.5 Notices.

10.5.1 Traffic Routing. Unless otherwise specified, 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. The foregoing shall apply to progressive modifications of traffic routings within an area in which work is in progress. Additional requirements for traffic routing are specified in SECTION: DETOURS, STREET RECONSTRUCTION, AND TRAFFIC CONTROL FACILITIES.

10.5.1.1 Stanford Drive. The Contractor shall notify The Flood Control District of Maricopa County (FCDMC) not less the 60 calendar days prior to closing Stanford Drive to through traffic. Convenient passage through the work shall be provided at all times to all driveways, houses, and mailboxes in the vicinty of the work. The Contractor shall notify FCDMC at (602) 262-1501 (Mr. Bob Payette).

10.5.2 Appropriate City and/or County 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. Unless otherwise specified, the Contractor shall notify the Contracting Officer, in writing, 30 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. John E. Rodriguez
Telephone: (602) 262-1501

Arizona Public Service
Metro Engineering Service
P.O. Box 21666
2121 W. Cheryl Drive
Phoenix, Arizona 85036
Ms. Lois Winkler
Telephone: (602) 371-6837

Southwest Gas Corporation
9 South 43rd Avenue
Phoenix, Arizona 85072-2075
Mr. Ron Morency
Telephone: (602) 484-5306

Salt River Project
Operations - Water
P.O. Box 1980
Phoenix, Arizona 85001
Mr. Timothy S. Phillips
Telephone: (602) 236-2956

City of Phoenix
Engineering Department
125 E. Washington Street
Phoenix, Arizona 85004
Mr. Dwayne Williams
Telephone: (602) 256-3441

City of Phoenix
Water Department
Mr. Gerald Arakaki
Telephone: (602) 261-8229

Salt River Project
- Electrical
Mr. Chuck Hughes
Telephone: (602) 236-2090

Dimension Cable Services
Mr. Blair Tanner
or Mr. John Barnett
Telephone: (602) 866-0072

U.S. West Communications
6350 S. Maple Avenue
Tempe, Arizona 85283
Mr. Curt Sayer
Telephone: (602) 831-4777
or
Mr. Robert Friess
2233 W. Dunlap Avenue
Room 205
Phoenix, Arizona 85021
Telephone: (602) 395-2550

10.5.3.1 Staking of Utilities. In addition to notification of representatives of utility owners, the Contractor shall notify the Blue Stakes Center, phone (602) 263-1100, nt less than 7 calendar days prior to start of excavation within street right-of-way or, work in the vicinity of known underground utilities, to have underground utilities located and staked.

10.5.3.2 The Contractor shall consult with the Salt River Project to obtain the footing depths of the transmission line towers on the north bank of the Arizona Canal east of 24th Street and the elevation to which the footings will be exposed from the Salt River Project.

10.5.4 Permanent Utility Relocations by Others. Except as otherwise specified, 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 Optional Disposal Areas. The Contractor shall notify the Contracting Officer within 30 calendar days after receipt of Notice to Proceed, as to which optional disposal areas he proposes to use or whether the areas will not be used for disposal. Should the Contractor elect to use any of the disposal areas, he shall indicate the approximate quantities of material he proposes to place in each area. In addition to the above requirements, the Contractor shall notify the Contracting Officer 24 hours in advance of the time he proposes to start operations in the optional disposal area, and 48 hours in advance of any work which he proposes to do in the disposal areas on Saturday, Sunday or legal holidays.

10.5.6.1 The Contractor shall submit a grading plan for the optional disposal areas to the Contracting Officer for approval not less than 14 calendar days prior to start of disposal operations.

10.5.7 Stormwater Pump Stations at Stations 841+60 and 846+95. Electrical service to the pump stations will be discontinued after notification by the Contractor. The Contractor shall notify the Salt River Project (SRP) as specified hereinbefore not less than 30 calendar days prior to the date that work is started at each location. The pump and other mechanical equipment shall be salvaged and delivered to the City of Phoenix (COP). The Contractor shall notify COP (Mr. Ross Blakely at 256-4371) not less than 30 calendar days prior to the date that work is started at each location.

10.5.8 Overhead Power Lines at Station 800+80. Electrical service to the pump station at Station 800+80 and the overhead power lines will be discontinued after notification by the Contractor. The Contractor shall notify the Arizona Public Service (APS) as specified hereinbefore not less than 30 calendar days prior to the date that work is started at each location. The pump and other mechanical equipment shall be salvaged and delivered to the City of Phoenix (COP). The Contractor shall notify COP (Mr. Ross Blakely at 256-4371) not less than 30 calendar days prior to the date that work is started at each location.

10.5.9 SRP Power Pole at 32nd Street and Stanford Drive. The Contractor shall protect the existing SRP power pole at the southeast corner of 32nd Street and Stanford Drive in place. In the event that is necessary to brace or otherwise support the pole, the Contractor shall notify SRP as specified hereinbefore and shall be responsible for all costs connected thereto.

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

a. The Contractor shall remove all construction materials placed in this area as a result of its operations under this contract after completion of construction.

b. Convenient passage through the area shall be provided at all times to authorized employees of the Salt River Project.

c. The area may only be used by the Contractor for conveyance of construction equipment and for temporary parking of construction equipment.

c. The Contractor shall provide dust control in accordance with SECTION: ENVIRONMENTAL PROTECTION.

d. The Contractor shall protect permanent features in the area in accordance with the CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS.

e. The Contractor shall submit a plan of proposed haul roads through the area for approval not less than 14 calendar days prior to start of construction operations. The Contractor will not be permitted to proceed with hauling operations without the prior written approval of the Contracting Officer. The Contractor shall coordinate

with all landowners and public entities, for the use of property outside the limits of work under this contract, and shall provide copies of all written agreements to the Contracting Officer, with his plan.

10.6.3 Access to the project will only be permitted from 12th Street, 16th Street, Glendale Avenue, Maryland Avenue, 24th Street, 32nd Street, and 40th Street.

10.6.4 The Contractor will not be permitted to cross existing paved roadways and residential roadways with construction equipment except at approved marked crossings. The Contractor shall maintain the crossings in accordance with applicable state, county, and city regulations.

10.6.5 Arizona Canal. Removal and/or repair of Arizona Canal bank lining will be permitted only during the annual dry-up period. The annual dry-up period is expected to occur from the first week of January through the first week of February 1991 and the Salt River Project (SRP) is expected to complete the canal lining from 24th Street to 32nd Street during that period. Requests to perform work outside of this period will require written permission from the SRP, and is not easily obtained. For calendar year 1992 the expected dry-up period can be obtained from SRP as specified hereinbefore.

10.6.6 12th Street, Maryland Avenue, and 32nd Street. Construction of Bridges at 12th Street, Maryland Avenue, and 32nd Street will be completed by others. Construction of the bridges is expected to be completed by December 15, 1990. The Contractor shall coordinate its construction operations with the bridge construction by contacting the Flood Control District of Maricopa County (FCDMC) as specified hereinbefore.

10.6.7 Phoenix Country Day School. Construction of Cudia City Wash sediment basin and pedestrian bridges from Station 1005+40 to the upstream limit of work under this contract will not be permitted to commence prior to July 1 and shall be completed not later than November 30. The Contractor shall provide dust control in accordance with SECTION: ENVIRONMENTAL PROTECTION.

10.6.8 Adjacent Arizona Canal Diversion Channel (ACDC). Construction of adjacent portions of ACDC will be in progress during the work covered by this contract. The Contractor shall cooperate and coordinate with the construction contractor (Pulice Construction, Inc.) for this work. The contact for Pulice will be Mr. Don Webb at (602) 944-2241.

10.6.9 Arizona Biltmore Hotel. Work in the vicinty of the Arizona Biltmore Hotel shall be completed within the limits specified in the SPECIAL CLAUSES, as shown on the drawings, and shall be subject to the following restrictions:

10.6.9.1 The Contractor shall provide convenient passage through the work to the existing Hotel Southbound Drive bridge (Station 921+72) at all times. In the event that a detour is necessary, the Contractor shall submit a detour plan to the Contracting Officer for approval not less than 30 calendar days in advance of the date that the existing bridge is closed to through traffic. The detour plan shall include a traffic flow diagram for each phase of the work.

10.6.9.2 The Contractor shall provide convenient passage through the work to the existing Hotel Golf Course bridge (Station 942+70) at all times. In the event that a detour is necessary, the Contractor shall submit a detour plan to the Contracting Officer for approval not less than 30 calendar days in advance of the date that the

existing bridge is closed to through traffic. The temporary bridge shall have a clear 10-foot travel width and shall be designed for H-10 loading by a registered engineer in the State of Arizona.

10.6.9.2 The Contractor shall erect temporary fencing at the Arizona Biltmore Hotel from aproximatly Station 920+30 to Station 935+30 and at the Dessrt Crest Retirement Home from aproximately Station 882+00 to Station 866+85. Materials for the fencing need not be new provided they are adequate for the intended use. Fencing shall be 8-foot in height and shall provide a visual barrier as well as a physical barrier.

11. PUBLIC SAFETY. Attention is directed to the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. The Contractor shall furnish, install, maintain and remove temporary fencing, barricades, and/or guards, as required, to provide protection in the interest of public safety and in conformance with applicable Federal, State, and local laws and ordinances. As a minimum, this will include an 8-foot chain-link fence which completely encloses each and every part of the projects (except at optional disposal areas) which the Contractor worked in or is working on. The plan of this temporary fencing shall be furnished to the Contracting Officer for approval and the fence erected prior to commencement of any work. 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.

13.1 General. Reference is made to the clause of the contract entitled "Permits and Responsibilities," which obligates the Contractor to obtain all required licenses and permits.

13.1.1 Waterline Shutdown Permit. The Contractor shall obtain a waterline shutdown permits within 30 calendar days of the notice to proceed. A copy shall be furnished to the Contracting Officer. The application process is expected to take 14 calendar days and the Contractor will pay a fee which is assessed to each application.

14. REQUIRED INSURANCE.

14.1 Reference is made to the clause of the contract entitled "Insurance - Work on a Government Installation," which obligates the Contractor to procure and obtain during the entire period of his performance under this contract the following minimum insurance:

14.1.1 Either Workman's Compensation or Employer's Liability Insurance with a minimum limit of $300,000.

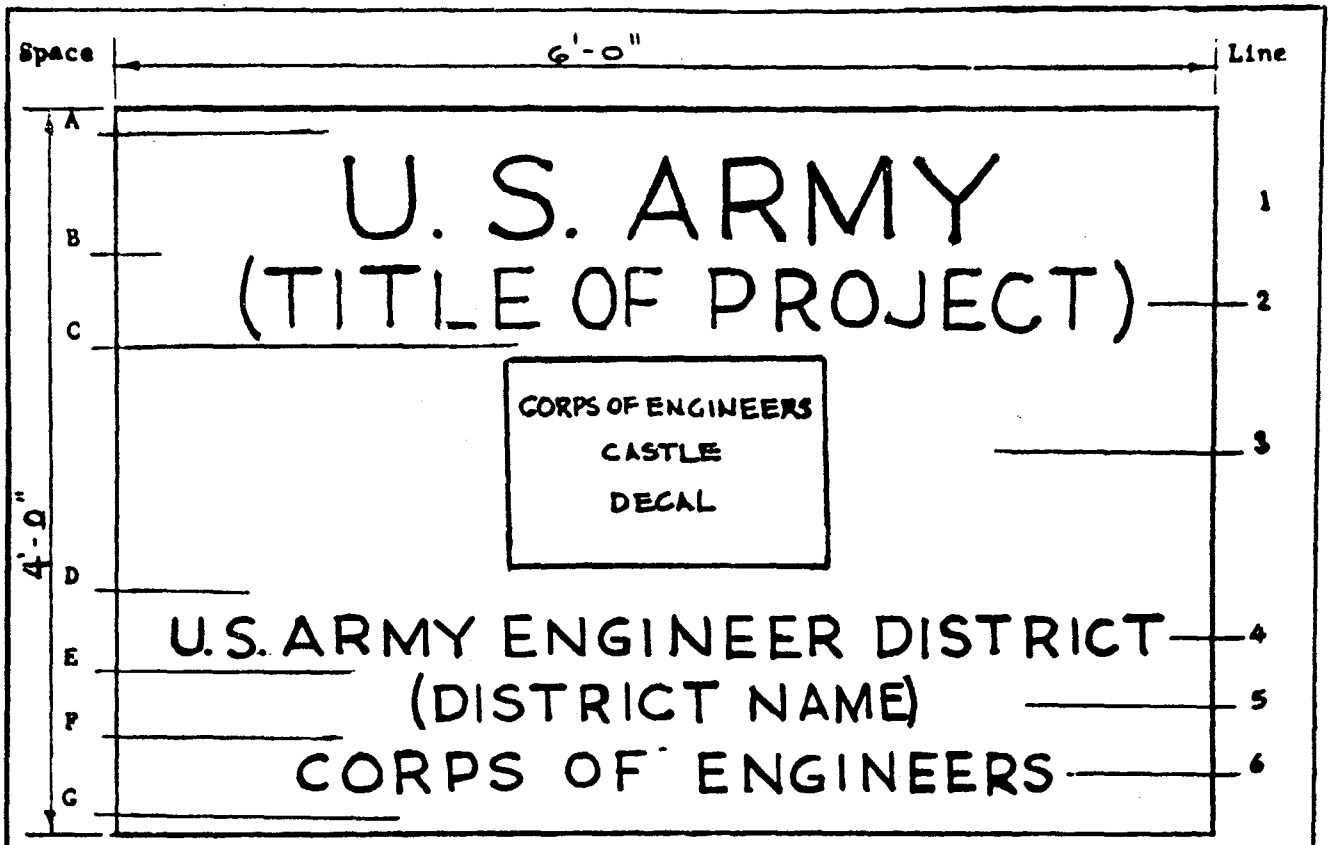
14.1.2 Compensation Liability Insurance for Bodily Injury and Property Damage with minimum limits of $100,000 for injury to or death of any person; $300,000 for each accident or occurrence for bodily injury liability; and $25,000 for each accident or occurrence for property damage liability.

14.1.3 Automobile Liability Insurance for Bodily Injury and Property Damage with minimum limits of $100,000 for injury to or death of any one person; $300,000 for each accident or occurrence for bodily injury liability; and $25,000 for each accident or occurrence for property damage liability.

14.1.4 In every case the insurance coverage shall amount to at least the limits stated above. However, where the Financial Responsibility Compulsory Insurance Law of the State in which the installation is located requires higher limits, the Automobile Liability Insurance Policy should provide coverage of at least those limits. The City of Phoenix, the Maricopa County Flood Control District, and the Town of Paradise Valley shall be named as additionally insured in all policies issued as a result of this contract.

15. PROGRESS PAYMENTS. Reference is made to the clause of the contract entitled "Prompt Payment for Construction Contracts," which obligates the Government to make invoice payments within a specified period of time. In order to adequately inspect the work and determine the adequacy of the Contractor's performance under the contract, the Government will require 25 calendar days for making such payments in lieu of the 14 days listed in the clause.

* * * * *



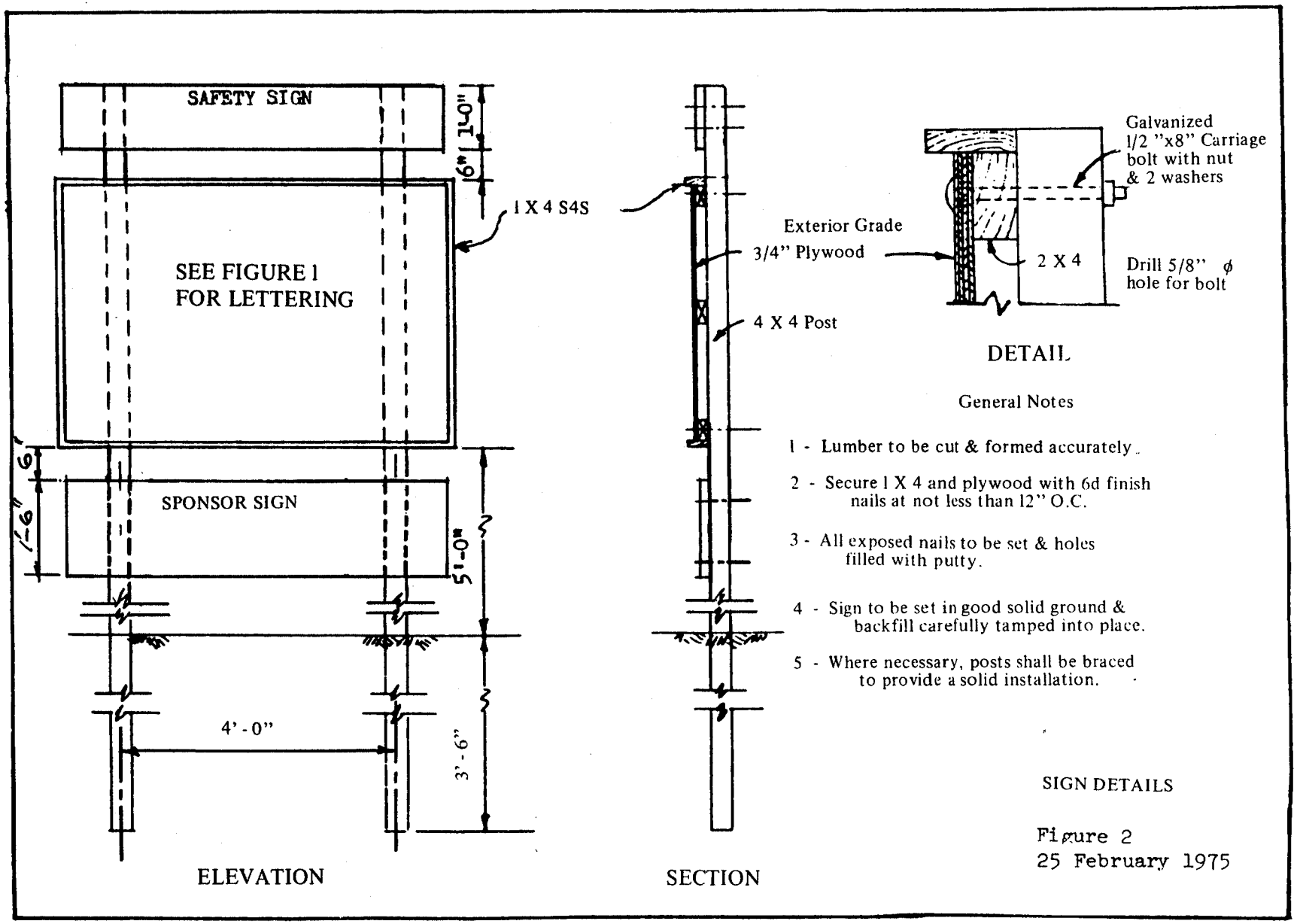
S C H E D U L E

Space	Height	Line	Description	Letter Height	Stroke
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)	14"	--
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



General Notes

1 - Lumber to be cut & formed accurately.

2 - Secure 1 X 4 and plywood with 6d finish nails at not less than 12" O.C.

3 - All exposed nails to be set & holes filled with putty.

4 - Sign to be set in good solid ground & backfill carefully tamped into place.

5 - Where necessary, posts shall be braced to provide a solid installation.

SIGN DETAILS

Figure 2
25 February 1975

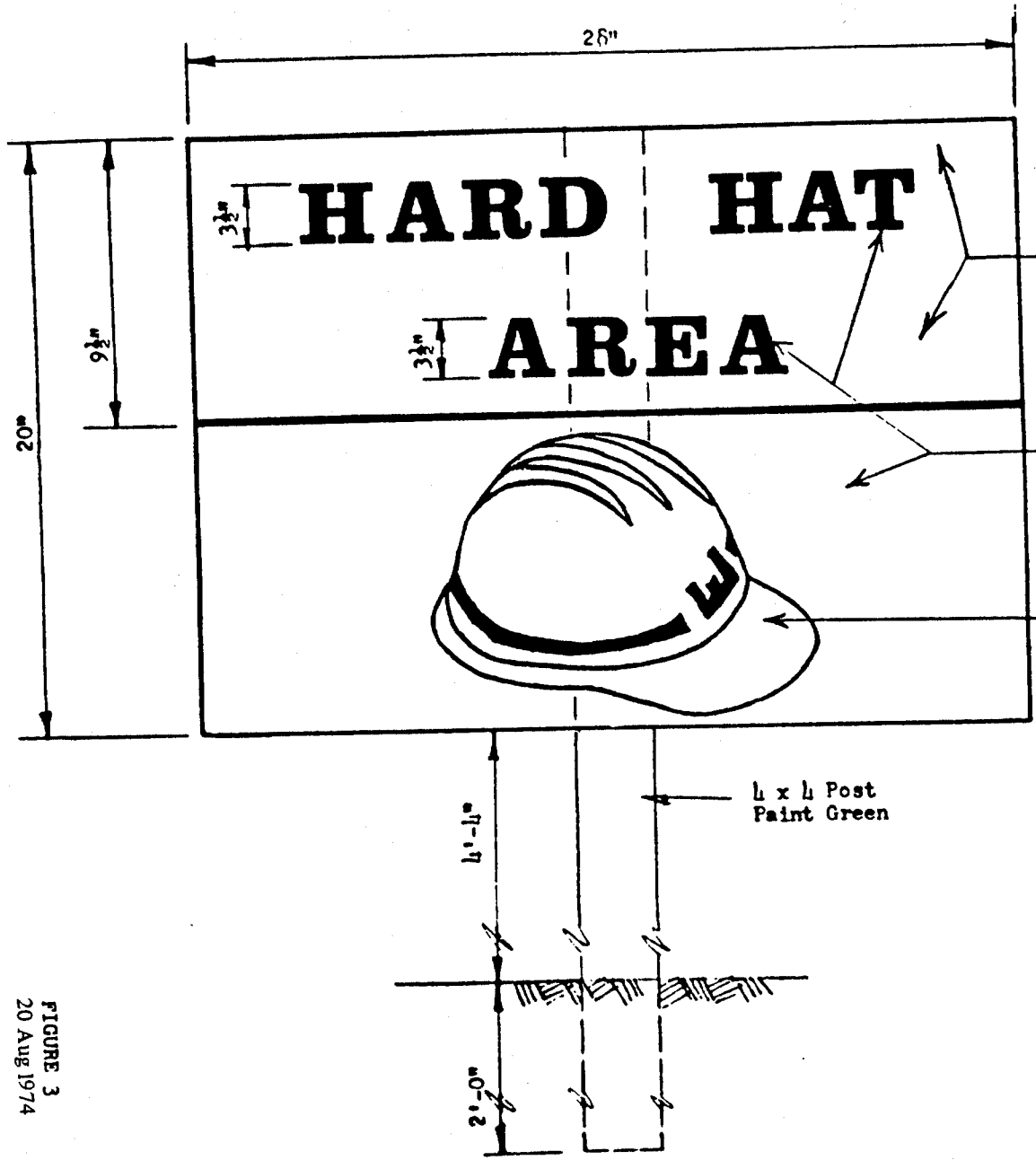


FIGURE 3
20 Aug 1974

General Notes

1. Green & White Paint shall be opaque glossy as specified in ANSI Standard Z53.1
2. Bolt Sign to Post w/2½" dia. Carriage Bolts.

SECTION 1B

MEASUREMENT AND PAYMENT

Index

1. DIVERSION AND CONTROL OF WATER. Payment for Diversion and Control of Water will be made at the applicable contract price, which payment shall constitute full compensation for maintaining the work area in a dry condition.

2. CLEAR SITE AND REMOVE OBSTRUCTIONS.

2.1 General. Payment shall include all costs for clearing, removal, replacement, and restoration work (except work by others) including all existing obstructions within the channel rights-of-way, fill sites, and the obstructions indicated for removal outside of the rights-of-way and inside the construction easements. Except as otherwise specified, payment for clearing and removal of work includes applicable earthwork; filling holes, removing and plugging abandoned lines; removal of existing swimming pools, asphalt, other structures, slabs, and sidewalks; removal of materials for salvage; protection, replacement or restoration of utilities, fences, walls and features indicated and disposal of all materials.

2.2 Payment for Clear Site and Remove Obstructions will be made at the applicable contract price, which payment shall constitute full compensation for clearing, obstruction removal, and protection work, complete. Payment will not be included for clearing, obstruction removal, or protection work for 35th Street side drain for which separate payment is provided.

3. EXCAVATION.

3.1 Measurement.

3.1.1 Excavation. A survey of the site shall be made prior to commencement of work, and all measurements will be based on this survey without regard to any changes in the site that may be made between the excavation lines and grades indicated on the drawings or staked in the field and the ground surfaces as indicated by the above

mentioned survey. The actual slopes as excavated may be greater or less than those indicated or staked, depending on the materials excavated and methods used in performing the work, but such alterations shall not change the measurement for payment from the original lines as specified herein. The quantity of directed excavation necessary for the removal of unsuitable foundation material as specified shall be included in the measurement of the excavation where the unsuitable soils are encountered. Quantities will be computed in cubic yards by the average end area method and the planimeter will be considered a precise instrument for measurement of plotted cross sections. All excavation outside of excavation lines shown on the drawings will be considered as being for convenience of the Contractor.

3.2 Payment.

3.2.1 Payment for Excavation will be made at the applicable contract price, which payment shall constitute full compensation for excavation for channel construction (including shoring, rock removal, and cemented alluvium excavation) and other areas as indicated on the drawings; shaping and trimming of areas to receive concrete; and loading, hauling, placing, and grading (including excess excavated material) into optional disposal areas. Payment will not be included for excavation (including shoring) outside the limits of channel and basin excavation at 32nd Street sanitary sewer, Stanford Drive reconstruction, 24th Street Detour, 24th Street Sanitary Sewer, 35th Street side drain, low flow channel bridges, and other earthwork requirements for which separate payments are provided.

3.2.2 Subgrade Preparation. No separate payment will be made for subgrade preparation and all costs in connection therewith shall be included in the contract prices for the items to which the work applies.

3.2.3 Excavation for Structures. No separate payment will be made for excavation for structures. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

3.2.4 Trenches. No separate payment will be made for excavation of pipeline trenches. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

3.2.5 Shoring. No separate payment will be made for shoring either indicated or required. All costs therefore shall be included in the applicable excavation or lump sum items as applicable.

4. FILLS.

4.1 Measurement for payment for fills will be made between the excavation and structure lines and the fill limit lines, or between the ground lines and fill lines, as indicated or staked in the field. Quantities will be computed in cubic yards by the average end area method and the planimeter will be considered a precise instrument for measuring plotted cross sections.

4.2 Payment.

4.2.1 Payment for Compacted Fill, Channel will be made at the applicable contract price, which payment shall constitute full compensation for placing and compacting the fills behind vertical channel walls, complete. Payment will not be included for fills outside the limits of channel and basin fills at 32nd Street sanitary sewer, Stanford Drive reconstruction, 24th Street Detour, 24th Street Sanitary Sewer, 35th

Street side drain, low flow channel bridges, and other earthwork requirements for which separate payments are provided.

4.2.2 Payment for Compacted Fill, Backfill Toe will be made at the applicable contract price, which payment shall constitute full compensation for placing and compacting the fills placed over the grouted stone protection, complete.

4.2.3 Payment for Select Fill will be made at the applicable contract price, which payment shall constitute full compensation for obtaining, placing, and compacting the fill, complete.

4.2.4 Fill for Structures. No separate payment will be made for fill or backfill about structures. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

4.2.5 Trenches. No separate payment will be made for backfilling trenches for utilities and pipelines. All costs therefore shall be included in the applicable contract prices for the items to which the work applies.

4.5 Payment for Compacted Fill, Miscellaneous will be made at the applicable contract price, which payment shall constitute full compensation for construction of the miscellaneous fill, complete, which includes furnishing materials, placing and compaction.

5. CONCRETE.

5.1 Measurement of Concrete will be made on the basis of the actual volume of concrete within the pay lines of the channel walls, channel invert, covered channel, and dental concrete as indicated on the drawings. Measurement of concrete placed against the sides of any excavation without the use of intervening forms will be made only within the pay lines of the structures. No deductions will be made for rounded or beveled edges or space occupied by metalwork, electrical conduits, or timber, nor voids or embedded items which are either less than 5 cubic feet in volume or one square foot in cross section. Concrete placed in items of work other than those specifically mentioned above, and concrete wasted or used for the convenience of the Contractor will not be included in measurement for payment.

5.2 Payment for Concrete will be made at the applicable contract prices for the various items of the schedule, which payments shall constitute full compensation for labor, materials (except cement, reinforcing steel, and color admixture for which other payment is provided), forming, finishing, curing, and for all equipment and tools to complete the concrete work. Embedded items shall be included in the cost of the concrete except when other payment is specifically provided. No payment will be made for concrete, as such, which is placed in structures for which payment is made on a lump sum basis.

5.2.1 Payment for Concrete, Invert will be made at the applicable contract price, which payment shall constitute full compensation for all concrete placed in the rectangular channel invert, covered channel invert, outlet channel invert, Cudia City Wash Spillway invert, invert access ramp inverts, and spillway cutoff wall (upstream invert). Payment will not include underpass ramp inverts for which separate payment is provided.

5.2.2 Payment for Concrete, Walls will be made at the applicable contract price, which payment shall constitute full compensation for all concrete placed in the walls

of rectangular channels, covered channels, invert access ramps, outlet channels, and Cudia City Wash Spillway. Payment will also include bridge transition walls and channel lining (except shotcrete for which other payment is provided) at 12th Street, 16th Street, Maryland Avenue, Glendale Avenue, 32nd Street, and Squaw Peak Parkway Bridges and "blockouts" required for installation of posts for steel picket fence. Payment will not be included for underpass ramp walls for which separate payment is provided.

5.2.3 Payment for Concrete, Top Slab will be made at the applicable contract price, which payment shall constitute full compensation for all concrete placed in the top slap of the covered channel, parapets on covered channel top slabs and fillets. Payment will also include "blockouts" required for installation of posts for steel picket fence.

5.2.4 Payment for Concrete, Dental will be made at the applicable contract price, which payment shall constitute full compensation for the dental concrete placed in the invert of the rectangular channel between the "B" line and the "A" line, as indicated on the drawings, complete. Dental concrete placed beyond the "B" line or wasted at the convenience of the Contractor will not be included in the measurement for payment.

6. COLOR ADMIXTURE. Payment for Color Admixture will be made at the applicable price, which payment shall constitute full compensation for obtaining materials and batching of color admixture in concrete for walls and inverts of channel (including the first 50 feet from each end of the covered channel section); invert access ramps; overflow and maintenance road spillways; curb and gutter adjacent to maintenance road and curb for maintenance road spillways; grout for grouting stone protection; intake box; Cudia City Wash spillway conduits; and other exposed concrete surfaces, complete. Payment will not be included for 12th Street and 16th Street underpass ramps, covered channel section (except 50 feet from each end), sidewalks, driveway and concrete curb at ~~parking lot.~~ Payment shall also include costs for test panels for colored concrete.

7. PORTLAND CEMENT.

7.1 Measurement. The quantity to be paid for will be the number of hundredweight (100 pounds) of Portland cement used in the concrete paid for on a cubic yard basis and used in the grouting of stonework unless specifically excepted, wasted, or used for the convenience of the Contractor. The quantity to be paid for will be determined by multiplying the approved batch weight of Portland cement by the number of batches of concrete placed within the pay lines of the structures divided by 100.

7.2 Payment for Portland Cement will be made at the applicable contract price, which payment shall constitute full compensation for furnishing the Portland cement, complete, ready for use in the work. Payment will not be included for Portland cement used in 35th Street side drain.

8. STEEL REINFORCEMENT.

8.1 Measurement of Steel Reinforcement is limited to reinforcement in concrete structures paid for on a cubic yard basis and will be made of the lengths of bars actually placed in the completed work in accordance with the plans and specifications, approved bar schedules, or as directed. The measured lengths will be converted to weights for the bar numbers listed by the unit weights per linear foot contained in ASTM A 615. Steel in laps indicated on the drawings, in the specifications, or

required by the Contracting Officer will be included in measurement for payment. No measurement will be made for the additional steel in laps which are authorized for the convenience of the Contractor. No measurement will be made of steel supports or spacers. All costs for furnishing and installing supports and spacers shall be included in the various structures requiring the reinforcement.

8.2 Payment for Steel Reinforcement will be made at the applicable contract price, which payment shall constitute full compensation for furnishing and installing steel reinforcement, complete.

9. OVERFLOW SPILLWAYS. Payment for Overflow Spillways will made be at the applicable contract price, which payment shall constitute full compensation for construction of the overflow spillways, the maintenance road overflow spillways, and concrete side slopes at Cudia City Wash sediment basin including applicable earthwork and subgrade preparation; forming; aprons; cut-off walls; concrete curbs adjacent to spillways; reinforcement; placing; finishing; and curing of concrete, complete. Payment will not be included for color admixture for which separate payment is provided.

10. ASPHALT CONCRETE PAVEMENT.

10.1 The unit of measurement for the asphalt concrete will be the ton (2,000 lbs.). The Contractor shall weigh each load on a certified platform scale and shall furnish the Contracting Officer with duplicate Weighmaster's Certificates showing the actual net weights. One ticket shall be furnished to the plant inspector and one ticket to the inspector. The bituminous mixture shall be weighed after mixing and no deduction will be made for the weight of bituminous material incorporated therein. Asphalt concrete used for the convenience of the Contractor will not be measured for payment. No measurement will be made for asphalt concrete used in items paid for under separate bid items.

10.2 Payment for Asphalt Concrete Pavement will be made at the applicable contract price, which payment shall constitute full compensation for asphalt concrete in place, including prime coat and weed killer, aggregate base course, subgrade preparation, tack coat, and all incidentals. Payment will not be included for asphalt concrete paid for under separate bid items. No payment will be made for excessive thickness.

11. STEEL PICKET FENCE. Payment for Steel Picket Fence will be made at the applicable contract price, which payment shall constitute full compensation for steel picket fencing and gates, complete including colored concrete posts, fence panels, paint, anchor bolts or expansion bolts, steel plates, grout or dry pack, hinges, chains, plunger rods, and all incidentals. Payment will not be included for picket fence on underpass ramps, irrigation station enclosures, 32nd Street sanitary sewer, Stanford Drive reconstruction, 24th Street Detour, 24th Street Sanitary Sewer, 35th Street side drain, and low flow channel bridges, for which separate payments are provided.

12. SIDE DRAINS. Payment for Side Drains will be made at the applicable contract price, which payment shall constitute full compensation for construction of side drains, complete including earthwork, concrete, flap gates, inlet structures, grates, concrete swale, collars, and bulkheads. Payment will not be included for 35th Street side drains, 24th Street Detour, and 24th Street Sanitary Sewer for which separate payments are provided.

13. MISCELLANEOUS HARDWARE. Payment for Miscellaneous Hardware will be made at the applicable contract price, which payment shall constitute full compensation for pipe

gates, pipe gate signs, reflectors, pipe gate stoppers, manhole ladders, invert access ladders, precast concrete manholes, sediment range markers, guard rails (except guard rail between Sta. 853+85 and Sta. 850+00), manhole covers, and applicable concrete and earthwork, complete. Payment will not be included for color admixture for concrete for which separate payment is provided.

14. DRIVEWAY ENTRANCES. Payment for Driveway Entrance will be made at the applicable contract price which payment shall constitute full compensation for the driveway entrances, complete including demolition and removal of existing curb, gutter, and pavement; earthwork outside the limits of channel earthwork; concrete (including cement and steel reinforcement); sidewalks; expansion joints; depressed curbs; and all incidentals necessary to match existing street, curb, gutter, and sidewalks. Payment will not be included for 32nd Street sanitary sewer, Stanford Drive reconstruction, 24th Street Detour, 24th Street Sanitary Sewer, 35th Street side drain, and low flow channel bridges, for which separate payments are provided.

15. STATION MARKING. Payment for Station Markings will be made at the applicable contract price, which payment shall constitute full compensation for materials and application necessary for the work, complete in place.

16. GAGING STATION. Payment for Gaging Station will be made at the applicable contract price, which payment shall constitute full compensation for the gaging station, complete including concrete, manhole, aluminum manhole cover and frame, and pipe.

17. CUDIA CITY WASH SPILLWAY CONDUITS. Payment for Cudia City Wash Spillway Conduits will be made at the applicable contract price, which payment shall constitute full compensation for materials, fabrication, and installation of conduits, headwalls, forming, concrete, concrete cradles and encasement and steel reinforcing (excluding color admixture for concrete encasement), complete in place.

18. INTAKE STRUCTURE. Payment for Intake Structure will be made at the applicable contract price, which payment shall constitute full compensation for the intake structure, earthwork; including steel angles, bars, anchor or expansion bolts, steel reinforcement, forming and concrete, complete. No payment will be included for color admixture for concrete in this bid item.

19. SHOTCRETE. Payment for Shotcrete will be made at the applicable contract price, which payment shall constitute full compensation for application of shotcrete where indicated, complete including reinforcing mesh and test panel.

20. MISCELLANEOUS ITEMS OF WORK. Payment for Miscellaneous Items of Work will be made at the applicable contract price, which payment shall constitute full compensation for furnishing and installing drinking fountains complete with connections to water lines, valves, fittings, drainage pit, earthwork, and street repair; security lighting complete with meters, service connectors, earthwork, conduits, street repair, pull boxes, light poles, light fixtures, and electric panels; bike racks; trash receptacles; and bollards, complete. Payment will not be included for bollards at 35th Street side drain for which separate payment is provided.

21. 12TH STREET AND 16TH STREET UNDERPASS RAMPS. Payment for 12th Street and 16th Street Underpass Ramps will be made at the applicable contract price, which payment shall constitute full compensation for all labor, materials and equipment to construct the underpass ramp walls and inverts at 12th Street and 16th Street. Payment will include earthwork, concrete, forming, reinforcing steel, picket fence, color

admixture, finishing and curing, complete. Payment will not be included for security lighting for which separate payment is provided.

22. STONE.

22.1 Measurement. The quantity of stone to be paid for will be the number of tons of stone determined by scale weights acceptably placed within the lines and grades shown on the drawings or directed by the Contracting Officer.

22.2 Payment for Stone will be made at the applicable contract price, which payment shall constitute full compensation for furnishing and placing the stone, complete.

23. GROUTING STONEWORK.

23.1 Measurement. The quantity of grout to be paid for will be measured to the nearest cubic yard by weighing all ingredients in trial batches of grout and converting each batch to absolute volume; the volume thus determined and the number of batches of grout of corresponding proportions acceptably placed in the work shall be used to determine the quantity of grout.

23.2 Payment for Grouting Stonework will be made at the applicable contract price, which payment shall constitute full compensation for mixing, transporting, placing, finishing, and curing grout (excluding Portland cement and color admixture) used for grouting stonework, complete. Payment will not be included for grout at 35th Street side drain for which separate payment is provided.

24. CURB AND GUTTER.

24.1 Measurement of Curb and Gutter will be made to the nearest linear foot measured horizontally from end-to-end of the curb and gutter in place.

24.2 Payment for Curb and Gutter will be made at the applicable contract price, which payment shall constitute full compensation for all labor, material and equipment to construct the curb and gutter, including transitions, subgrade preparation, forming, and finishing, complete. Payment will not be included for curbing and curb and gutter adjacent to driveway entrances, overflow spillways, maintenance road spillway, paving stone edging; curb and gutters at 32nd Street sanitary sewer, Stanford Drive reconstruction, 24th Street Detour, 24th Street Sanitary Sewer, 35th Street side drain, low flow channel bridges; and curbing removed for the convenience of the Contractor.

25. LANDSCAPING. Payment for Landscaping will be made at the applicable contract price, which payment shall constitute full compensation for all labor, materials, and equipment necessary to furnish, install, protect, and maintain the plant materials as indicated on the drawings; furnish and install or construct landscape features, including screen walls, planters (including footings, and walls complete), concrete bands for landscape areas, sand base, interlocking pavers (including curbing and sand base), decomposed gravel, seat walls, retaining wall between Sta. 789+78 and Sta. 789+28, concrete headers, topsoil, and applicable earthwork.

26. IRRIGATION SYSTEM. Payment for Irrigation will be made at the applicable contract price, which payment shall constitute full compensation for all labor, materials, and equipment necessary to furnish, and install the irrigation system, complete including connection to existing water lines; irrigation stations (including enclosure fence, ramp and pad); electrical facilities to provide power to the

irrigation stations; and water used during the specified maintenance period.

27. SUBDRAINAGE SYSTEM. Payment for Subdrainage System will be made at the applicable contract price, which payment shall constitute full compensation for materials, and installation of the subdrainage system, complete including drain aggregate, pipe, fittings, and geotextile material.

28. 35TH STREET WASH DRAINAGE CULVERTS. Payment for the 35th Street Wash Drainage Culverts will be made at the applicable contract price, which payment shall constitute full compensation for the construction of box culverts at 35th Street, complete including concrete, reinforcement, earthwork, and bulkheads.

29. MANHOLE ADJUSTMENTS. Payment for Manhole Adjustments will be made at the applicable contract price, which payment shall constitute full compensation for all work necessary to adjust manholes to the final grade, complete.

30. 32ND STREET SANITARY SEWER. Payment for 32nd Street Sanitary Sewer will be made at the applicable contract price, which payment shall constitute full compensation for construction of the sewerline, complete including demolition and removal of existing roadway, earthwork, manholes, traffic control, and reconstruction of the roadway.

31. STANFORD DRIVE RECONSTRUCTION. Payment for Stanford Drive Reconstruction will be made at the applicable contract price, which payment shall constitute full compensation for construction of detour; demolition and removal of existing roadway (including driveways and sidewalk ramps); installation, maintenance, and removal of temporary traffic control facilities (including pavement markings); earthwork; removal and replacement of street lighting; protection and adjustments to existing utilities; construction of inlet structures and side drains; picket fencing; 36th Street pedestrian bridge; utility conduits at the covered channel; shoring required for covered channel construction between Sta. 975+00 and Sta. 963+50; and restoration of the roadway and appurtenant facilities as indicated on the drawings.

32. 24TH STREET DETOUR. Payment for 24th Street Detour will be made at the applicable contract price, which payment shall constitute full compensation for construction of the detour, complete including demolition and removal of existing roadway (including driveways and sidewalk ramps); installation, maintenance, and removal of temporary traffic control facilities (including pavement markings); earthwork; removal and replacement of street lighting; protection and adjustments to existing utilities; picket fencing; sandbags for existing 24th Street underpass; fireline detector check pipeline; utility conduits at the covered channel; shoring required for covered channel construction between Sta. 936+50 and Sta. 929+50 (left), between Sta. 935+00 and Sta. 933+70 (right), between Sta. 923+20 and Sta. 920+00 (left), between Sta. 789+80 and Sta. 785+50 (right), and between Sta. 782+75 and Sta. 779+00 (right); guard rails on the north side of the channel between Sta. 853+85 and Sta. 850+00; and restoration of the roadway and appurtenant facilities as indicated on the drawings.

33. 24TH STREET SANITARY SEWER. Payment for 24th Street Sanitary Sewer will be made at the applicable contract price, which payment shall constitute full compensation for construction of the sewerline, complete including demolition and removal of existing roadway outside the limits of 24th Street detour, earthwork, manholes, traffic control and reconstruction of the roadway outside the limits of 24th Street detour.

34. 35TH STREET SIDE DRAIN. Payment for 35th Street Side Drain will be made at the applicable contract price, which payment shall constitute full compensation for installation of reinforced concrete pipe, complete including, clearing, earthwork, concrete, grouted stonework, fencing, trash racks, aggregate base course, and appurtenant restoration of the area.

35. LOW FLOW CHANNEL BRIDGES. Payment for Low Flow Channel Bridges will be made at the applicable contract price, which payment shall constitute full compensation for construction of the bridges, complete including concrete, steel reinforcement, abutments, headwalls and curbing, fencing, and earthwork outside the limits of sediment basin excavation.

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SECTION 1C

CONTRACTOR'S QUALITY CONTROL

Index

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 15 days of operation. However, the Contractor shall furnish for approval by the Government, not later than 30 days after receipt of Notice to Proceed the Contractor Quality Control (CQC) Plan with which he proposes to implement the requirements of CONTRACT CLAUSE entitled "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 entitled "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.

2.3.7 At anytime when concrete is being placed or compacted, a quality control representative, independent of project supervision, shall be present.

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.

NOTE: Minimum staffing and qualifications may be specified.

4. SUBMITTALS. Submittals shall be as specified in the SPECIAL CLAUSE entitled "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.

8.2 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 by noon of workday following date of report.

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.

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SECTION 1D

ENVIRONMENTAL PROTECTION

Index

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, cacti, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archeological and cultural 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 ground water 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 nonuse. Plan should include measures for marking the limits of use areas.

(10) Methods for preventing the generation of dust due to construction operations in the work areas, along haul routes, in equipment parking areas, and in waste areas.

3.2 Implementation. After receipt of Notice to proceed, the Contractor shall submit in writing the above Environmental Protection Plan within 14 days. If the Contractor fails to submit an acceptable Environmental Protection Plan within the time herein prescribed, the Contracting Officer may refuse to allow construction to start or may withhold funds from progress payments in accordance with the CONTRACT CLAUSE entitled PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS until such time as the Contractor submits an acceptable final plan. 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 contract 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, cacti, 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 within the construction work limits 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 fenced or flagged. 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, cacti, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by fencing, flagging, 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 Temporary Protection of Disturbed Areas. Such methods as necessary shall be utilized to effectively prevent erosion and control sedimentation, including but not limited to the following:

(1) Retardation and control of Runoff. Runoff from the construction site shall be controlled by construction of diversion ditches, benches, and berms to retard and divert runoff to protected drainage courses, and any measures required by area-wide plans approved under paragraph 208 of the Clean Water Act.

6.1.5 Erosion and Sedimentation Control Devices. The Contractor shall construct or install all temporary and permanent erosion and sedimentation control features as necessary. Temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing and mulching shall be maintained until permanent drainage and erosion control facilities are completed and operative.

6.1.6 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 by the Contracting Officer. Due to the sensitive nature of riparian habitat in the basin, strict adherence to the designated areas is necessary. Temporary movement or relocation of Contractor facilities shall be made only on approval by the Contracting Officer.

6.1.7 Spoil Areas shall be managed and controlled to limit spoil to areas designated and prevent erosion of soil or sediment from entering nearby water courses or lakes.

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

6.1.9 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 and shall conform to the requirements of applicable local, State and Federal laws and regulations.

6.1.10 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. Crankcase oil and other waste chemicals shall be captured and not drained onto the ground.

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

6.2 Protection of Historical, Archeological and Cultural resources shall conform to the requirements of 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 ground waters. Special management techniques as set out below shall be implemented to control water pollution by the 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 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. A permit will be required by Maricopa County Bureau of Air Pollution Control that will require particulate suppression control.

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 hereinabove to be exceeded or which would cause a hazard or a nuisance. Sprinkling, treatment with an approved non-toxic dust palliative, 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. Construction will not be allowed between the hours of 6:00 p.m. and 7:00 a.m. without the prior written approval of the Contracting Officer.

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 plan submitted for approval by the Contracting Officer. This work will be accomplished at the Contractor's expense.

8. MAINTENANCE OF POLLUTION CONTROL FACILITIES. The Contractor shall maintain all constructed facilities and portable pollution control devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

9. 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 familiarization with cultural resource identification, and installation and care of facilities to ensure adequate and continuous environmental pollution control.

10. POST CONSTRUCTION CLEAN UP. The Contractor shall clean up all areas used for construction (including haul routes, disposal area) in conformance with CONTRACT CLAUSE: CLEANING UP.

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SECTION 1E

DETOURS, STREET RECONSTRUCTION,AND TRAFFIC CONTROL FACILITIES

1. DETOURS. Detours shall be constructed and maintained in accordance with all applicable state, county, and city traffic regulations. Detour plans shall be prepared and submitted for all required detours indicating surfacing, signing, striping, pedestrian access provisions and hours of operation. Plans shall be approved by the City of Phoenix, or other appropriate agency, as a condition of approval by the Contracting Officer.

2. REQUIRED DETOURS.

2.1 24th Street. A detour shall be constructed and maintained at 24th Street to permit continuous two-way traffic use 24 hours a day. The Contractor shall keep the detour in operation until removal is authorized in writing by the Contracting Officer.

2.2 Stanford Drive. A detour shall be constructed and maintained at Stanford Drive as indicated on the drawings.

3. DETOUR CONSTRUCTION.

3.1 General. Construction of the required detours shall conform to the details and notes on the drawings and as specified herein.

3.2 Earthwork shall conform to the requirements of SECTIONS: EXCAVATION and FILLS AND SUBGRADE PREPARATION.

3.3 Asphalt Concrete shall conform to the requirements of SECTION: ASPHALT CONCRETE.

3.4 Aggregate Base shall conform to the requirements of SECTION: AGGREGATE BASE.

3.5 The Contractor shall submit a plan for approval by the Contracting Officer, of the method of handling and transporting bridge beams to the site.

4. MAINTENANCE. The detour shall be maintained in a safe condition until it is removed. Installation and maintenance of traffic control facilities and detour surfaces, shall be performed by the Contractor. The surface shall be maintained without abrupt changes of grade in excess of 1/4 inch in 10 feet.

5. TRAFFIC CONTROL.

5.1 The Contractor shall furnish, install, maintain and remove all temporary barricades, lights, warning signs, flagmen and other facilities necessary to control the traffic and protect pedestrians within the limits of the construction area. All signs to be used on the project during periods of darkness shall be reflectorized. Traffic control shall conform to the City of Phoenix Barricade Manual; Section 400 of the Uniform Standard Specifications for Public Works Construction, Maricopa Association of Governments (MAG) and State of Arizona depending on jurisdiction.

5.2 The number and type of barricades, signs, delineators, barriers and all other traffic control devices shall be subject to approval, however, approval of traffic control devices and the approval of the Contractor's method of application of all traffic control measures, shall not relieve the Contractor of the responsibility of protecting the work, the workmen and the traveling public.

6. REMOVAL OF DETOURS AND RESTORATION.

6.1 The Contractor shall remove the detour and temporary bridges, remove materials from the site, and restore the site.

6.2 The area where the detour was placed shall be completely restored to its original condition, or as indicated in the drawings. This will include removal of the detour pavement, temporary fencing, temporary barriers and embankment, temporary bridges, and abutments to one foot below finish grade.

6.3 Utilities that had been moved or adjusted to accommodate the detour will be reset to an appropriate location and grade. Signs that were moved or changed for the detour will be replaced per their original location and type.

7. STREET RECONSTRUCTION.

7.1 Street Reconstruction includes all work necessary to reconstruct the street complete to the lines and grades as shown on the contract drawings.

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SECTION 2A

DIVERSION AND CONTROL OF WATER

1. REQUIREMENT.

1.1 General. All permanent construction shall be carried on in areas free from water. Water in varying quantities may be flowing in the basin and channels during the entire period of construction as a result of either rainfall or urban runoff. 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: DAMAGE TO WORK of the SPECIAL CLAUSES. All locations, where construction work to be performed is at a lower elevation than the water level, shall be dewatered prior to commencement of work. 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 a diversion plan showing the method that he proposes to use to dewater each working area and control the water from rain, sheet flow, urban runoff, side drains, any other surface water, seepage, and groundwater. The plans shall show the scheme of operations and a complete layout of drainage pipes, pumps, diversion channels, cofferdams, etc. The Contractor's diversion plan shall not permit water from any source to accumulate outside the construction limits. The plans shall also include 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 in addition any and all seepage and groundwater originating within the work. Flood flows are defined as follows:

a. Arizona Canal Diversion Channel (Cudia City Wash to Dreamy Draw) - Flows in excess of 3,000 cfs.

b. Cudia City Wash - Flows in excess of 2,000 cfs.

c. 35th Street Inlet - Flows in excess of 600 cfs.

d. Ocotillo Road - Flows in excess of 550 cfs.

e. Myrtle Avenue Wash -Flows in excess of 700 cfs.

1.3 Contractor shall be prepared to accept flood flows diverted to project area by the Arizona Canal.

1.4 Drainage Ditches. The location and depth of any drainage ditch to be constructed under this contract 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 stream bed or invert subgrade shall be refilled with compacted fill in accordance with SECTION: FILLS AND SUBGRADE PREPARATION by and at the expense of the Contractor.

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SECTION 2B

CLEARING SITE AND REMOVING OBSTRUCTIONS

1. PROTECTION.

1.1 Environmental Protection. All work and Contractor operations shall comply with the requirements of SECTIONS: ENVIRONMENTAL PROTECTION and EXCAVATION.

2. BURNING. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

3. REQUIREMENTS.

3.1 General. Except as otherwise specified, and/or indicated, areas to be cleared will be limited to actual excavation areas, areas to be landscaped, and areas on which fills and/or structures 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, turf, or vegetation which can be left in place.

3.2 Existing Structures and Obstructions. The Contractor shall clear and grub the site, fill, borrow, and excavation areas, and remove and dispose of all existing structures and obstructions for project construction, except as those structures which are identified to be protected in place as shown on the drawings. Obstructions which are designed or specified to be removed but which are not designated or specified to be removed by others shall be removed by the Contractor. 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 to be obstructions.

3.2.1 Clearing. Trees smaller than 1-1/2 inches in diameter and other vegetation, except as specified, shall be cut off 6 inches below the indicated channel subgrade or ground level whichever is lower. Other vegetation 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.

3.2.2 Grubbing shall consist of removing all trees, stumps, roots, logs, and other objectionable vegetable matter in the required fills, foundation areas, and all excavation areas. In grubbing out stumps and roots, all roots or other timber more than 1-1/2 inches in diameter shall be removed to 3 feet below the depth of the required excavation or existing ground level, whichever is lower. Trees and stumps shall be pulled, not cut off.

3.3 Utilities. Prior to removing an obstruction, all applicable utility relocations shall have been coordinated. Pipes designated by owners as "abandoned" shall be removed within the limits of the project as necessary for clearing. All abandoned pipes shall be plugged at the cut ends as shown on the drawings or as directed by the Contracting Officer.

4. DISPOSAL OF CLEARED, GRUBBED, AND REMOVED MATERIAL. All material removed, except material specified and/or indicated to be salvaged, is designated as scrap, shall become the property of the Contractor, and shall be removed from the site. Unsuitable materials from clearing operations may be temporarily used for diversion and control of water. Disposal shall be in accordance with the requirements of SECTION: ENVIRONMENTAL PROTECTION.

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SECTION 2C

EXCAVATION

Index

1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) Standards listed below forms a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM D 2487	(1985) Classification of Soils for Engineering Purposes

2. GENERAL. Excavation shall consist of the removal of every type of material encountered (except materials covered by the provisions of the SECTION: CLEARING SITE AND REMOVING OBSTRUCTIONS) in the designated areas or from areas directed. The material to be removed may include but is not limited to earth, hardpan, silt, clay, sand, gravel, soft to hard variably cemented alluvium, cobbles and boulders, rock, adobe, detached pieces of stone and concrete, rock fills, existing fills of miscellaneous debris and rubbish, and other unsuitable materials. "Rock" is defined as solid bedrock, fractured or decomposed or weathered bedrock, and boulders and blocks 1/2 cubic yard or more in volume. All blasting required for excavation shall conform to the requirements specified hereinafter in Paragraph: BLASTING. Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slope to which the excavation must be made to safely perform the work. Excavation for permanent cuts shall be made to the slope lines indicated. Excavation shall be performed in a manner which will not impair the subgrade. Except for rock excavation or as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 1/2 inch above or 2 inches below indicated grade.

2.1 Topsoil shall be stockpiled in accordance with SECTION: TREES, SHRUBS AND GROUND COVER.

3. BLASTING.

3.1 General. All blasting required for excavation shall conform to the requirements specified hereinafter and shall also be in accordance with the applicable portions of Section 107 of the Maricopa Association of Governments (M.A.G.) Uniform Standard Specifications, Article 12 of the City of Phoenix, Arizona Fire Prevention Code, and Regulations 12-A and 12-B of the Phoenix Fire Department, Division of Fire Prevention.

3.2 Safety Requirements. Reference is made to the clause of the contract entitled: ACCIDENT PREVENTION which obligates the Contractor to protect persons, property, materials, etc. from damage. Blasting will be permitted only when adequate precautions are taken to comply with the clause. Any damage to the work or property caused by blasting operations shall be repaired by the Contractor at no cost to the Government.

3.3 Permits shall be obtained in accordance with the applicable requirements of SECTION: GENERAL REQUIREMENTS. The Contractor shall obtain all required licenses and permits for the use of explosives and shall comply with all provisions and requirements of applicable laws, ordinances, and regulations in the transportation, storage, handling, and use of such explosives.

3.4 Utility Notification. The Contractor shall notify each public utility company, having structures adjacent to the work, of his intention to use explosives. Such notice shall be given in accordance with the applicable requirements of SECTION: GENERAL REQUIREMENTS.

3.5 Submittals.

3.5.1 Blasting Plan. The Contractor shall submit 3 copies of the proposed blasting plan to the Contracting Officer for approval not less than 30 calendar days prior to drilling for each blast. The proposed plan shall show the pertinent data on the location, depth, and area of the blast; the diameter, spacing, depth, overdepth, pattern, and inclination of the blast holes; the type, strength, amount, distribution, and powder factor for the explosives used per hole and per blast; the sequence and pattern of delays; the description and purpose of controlled blasting techniques, and the control of noise, dust, flyrock, airblast and ground vibrations.

3.5.2 Preblast Report. The Contractor shall submit 3 copies of a preblast inspection report of adjacent properties to the Contracting Officer for approval not less than 30 calendar days prior to commencing blasting operations. The report shall document, on drawings and by photographs, the locations of all existing cracks and damages to structures within 300 feet of the blast site. The report shall also include information on any property owners who refused to cooperate and permit entry and inspection.

3.6 Approval of Blasting Plan. Approval by the Contracting Officer of a blasting plan shall not relieve the Contractor of his responsibility to produce satisfactory results as set forth in these specifications. When a drilling and blasting program results in damage to the excavation or adjacent structures, the Contractor shall be required to modify his blasting plan, subject to approval by the Contracting Officer, to produce the desired results.

3.7 Personnel. During blasting operations, the Contractor shall have on the site, and in immediate charge of the blasting and rock and/or cemented alluvium excavation, a blasting expert, acceptable to the Contracting Officer, who has had no less than 3 years of continuous experience in controlled blasting and rock and/or rock cemented alluvium excavation operations. Powder handlers shall have no less than one year of continuous experience in preparation and loading of powder charges.

3.8 Blasting Procedures. Drilling and blasting within the diversion channel and Cudia City Wash sediment basin excavation shall be in accordance with the blasting plan approved by the Contracting Officer. The Contractor shall control the blasting procedures so as not to overshoot and shall be required to remove at his own expense, any material outside the lines and grades indicated on the drawings which may be shattered or loosened by such blasting.

3.8.1 Controlled Blasting. Controlled blasting techniques (i.e., presplitting, line drilling, or smooth blasting) shall be required for blasting within the diversion channel and Cudia City Wash sediment basin excavation and such other areas designated by the Contracting Officer. The explosives shall be of such strength and quantity and shall be used in such a manner that will neither open seams nor otherwise damage

the cemented alluvium rock outside of prescribed limits of excavation. Controlled blasting shall be performed in a manner which will produce relatively smooth and sound faces at the final excavation lines. Where blasting is performed for excavation, buffer zones are to be provided as indicated on the drawings. Within the buffer zones the depth and spacing of blast holes and the amount of explosives shall be varied with the field conditions to prevent damage to the rock cemented alluvium faces. Whenever, in the opinion of the Contracting Officer, blasting may injure the cut slopes or rock cemented alluvium upon which or against which concrete is to be placed, the use of explosives shall be discontinued and the excavation shall be completed by wedging, barring, channeling and broaching, or other suitable methods. Any damage to, or displacement of supports and any damage to any part of the work or adjacent structures caused by blasting shall be repaired by and at the expense of the Contractor and in a manner satisfactory to the Contracting Officer.

3.8.2 Blast Monitoring. For every blast, ground vibrations and airblast levels shall be monitored by the Contractor using calibrated blasting seismographs and appurtenant equipment approved by the Contracting Officer. No more than two seismographs shall be required for each blast. Seismograph recordings of vibration measurements in terms of particle velocity, airblast measurements in terms of decibels, and interpretations thereof shall be submitted to the Contracting Officer for approval prior to drilling for the next blast. Maximum ground vibrations and airblast levels permitted shall be in accordance with the most recent version of the Blasting Guidance Manual, Office of Surface Mining Reclamation and Enforcement, United States Department of The Interior.

3.9 Restrictions.

3.9.1 Blasting will not be permitted within 100 feet of concrete which has been in place less than 7 days.

3.9.2 Ammonium nitrate type explosives shall not be used along any final excavation lines or within any buffer zones where controlled blasting techniques are employed.

3.9.3 Use of non-electric blasting caps will be prohibited.

3.9.4 Blasting mats shall be used at all times and shall be in good repair. Steel mats shall not be allowed within 2,000 feet of powerlines.

3.10 Records. The Contractor shall keep and furnish to the Contracting Officer accurate logs and records of all operations pertaining to the preparation, drilling, blasting, blast monitoring, and excavation procedures for each round of blasting. The records shall be submitted daily with the Quality Control Report and shall include the following:

a. A plan view of the actual blast hole layout, located on each corner by stationing, top and bottom elevations, offset from centerline, and distances from final excavation lines. The plan sketch shall include the number, size, depth, orientation, and spacing of each drill hole utilized for each round of blasting.

b. The quantity, type, and strength of explosives, and stemming used in blasting each drill hole.

c. The type, make, and system of detonation used for each round of blasting.

d. The volume of rock/cemented alluvium excavated from each round of blasting.

e. Any unusual drilling or blasting occurrences.

f. The number, size, type, and make of all equipment used in the excavation process.

g. A copy of seismograph recordings of ground vibrations and airblast levels together with complete and accurate interpretations of such data.

4. PRESERVATION OF PROPERTY. All excavation operations shall be conducted in such a manner that street pavements, sidewalks, curbs, utilities, structures, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores or whatever means may be necessary to adequately support material carrying such improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores or other protective means shall remain the property of the Contractor and when no longer needed shall be removed from the site. The Contractor shall submit for approval all designs and shop drawings showing proposed method of shoring and bracing which he intends to use. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressure exerted by and the condition and nature of the materials to be retained, including surcharge imparted to the side of the trench by equipment and stored materials. Removal of shoring shall be performed in such a manner as not to disturb or damage the finished concrete.

4.1 Location of shoring shall be as indicated on the drawings.

4.2 The following soil parameters shall be used for the design of the temporary sheet piling, cribbing, bulkheads, shores or other protective means:

Wet unit weight	=	130 lbs/ft^3
Angle of internal friction	=	30 degrees
Coefficient of cohesion	=	0 lbs/ft^2

5. EXCAVATION FOR STRUCTURES. Excavation within the vicinity of existing structures, utilities, and drainage pipes to remain in place shall be performed in a manner to prevent damage to the structure. Earth banks and facilities to remain in place shall be supported as necessary during excavation. In general, unless otherwise shown or specified, the actual side slopes shall be in accordance with EM 385-1-1 (Safety Manual). Excavation adjacent to construction already in place shall not be lower than existing grade of that existing construction.

6. EXCAVATION FOR CURBS AND ROADS. Excavation for curbs and access roads shall include materials unsuitable for road subgrade. Unsuitable materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in ASTM D 2487 as ML, CL, MH, CH, PT, OH and OL.

7. EXCAVATION FOR SIDE DRAINS. Excavation for side drains shall conform to the requirements of SECTION: SIDE DRAINS.

8. REMOVAL OF UNSATISFACTORY SOILS. The removal of soils which are unsatisfactory for foundations of the channel, structures, streets, and drains, will be required in certain areas. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in ASTM D 2487 as ML, CL, MH, CH, PT, OH and OL. The Contractor will be

required to excavate any such areas to the depth directed and backfill the areas with compacted fill conforming to the requirements of the SECTION: FILLS AND SUBGRADE PREPARATION.

9. DISPOSAL OF EXCAVATED MATERIALS. Excavated materials suitable for compacted fill, structure fill, and other required fills, shall be placed in temporary stock piles or used directly in the work. All excess excavated material not disposed of within the optional disposal areas, excavated material not suitable for fills, and unsatisfactory material shall become the property of the Contractor and shall be removed from the site. No excavated material or waste of any kind shall be disposed of at any place beyond the limits of the work under this contract without express authority. Prior to placing fills in stock piles, or optional disposal areas, the site shall be cleared of trash and vegetation. Vegetation shall be cut off at the existing ground line. Clearing shall conform to the applicable requirements of SECTION: CLEARING SITE AND REMOVING OBSTRUCTIONS. Stock piles and disposal fills shall be placed in a manner to preclude the ponding of water. The Contractor shall furnish notification of his intention to use optional disposal sites in accordance with the requirements of SECTION: GENERAL REQUIREMENTS.

9.1 Additional requirements for disposal of excess material shall be as specified in the SPECIAL CLAUSES and SECTIONS: GENERAL REQUIREMENTS; ENVIRONMENTAL PROTECTION; and CLEARING SITE AND REMOVING OBSTRUCTIONS.

10. OVERCUT. Except as otherwise specified or as may be ordered in writing, any overcut or excavation made outside the lines indicated on the drawings or directed shall be backfilled with compacted fill conforming to SECTION: FILLS AND SUBGRADE PREPARATION for earth subgrades or concrete conforming to SECTION: CONCRETE, for rock subgrades and all excavating, backfilling, compacting of backfill, and concreting occasioned thereby shall be by the Contractor at no additional cost to the Government. Any overcut under bridge footings shall be backfilled with concrete.

11. TOLERANCES FOR ROCK EXCAVATION. Excavations for concrete structures have certain reference lines designated as "A" line and "B" line. The "A" line is located 6 inches above the "B" line in all inverts and 6 inches inside the "B" line in all walls. The "A" line represents the inner tolerance limit inside which no rock or dental concrete will be permitted to project. Any projections inside of "A" line shall be removed. The "B" line is the line to which measurement for payment of excavation will be made, and is considered to be the final excavation line indicated on the drawings. Measurement for payment will be made to this line regardless of whether the limit of the actual excavation falls inside or outside of it, but sufficient excavation inside of this line shall be performed to provide for the proper installation of steel reinforcement and placement of concrete. Any excavation beyond the "B" line shall be replaced with concrete complying with the applicable portions of these specifications without additional cost to the Government.

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SECTION 2D

FILLS AND SUBGRADE PREPARATION

Index

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 D 1556	(1982) Density of Soil In-Place by the Sand-Cone Method
ASTM D 1557	(1978) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb. (4.54 Kg) Rammer and 18-In. (457 mm) Drop
ASTM D 2216	(1980) Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil-Aggregate Mixtures
ASTM D 2487	(1985) Classification of Soils for Engineering Purposes
ASTM D 2922	(1981) Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)

2. COMPACTION EQUIPMENT.

2.1 General. Compaction shall be accomplished by tamping rollers, steel drum rollers or vibratory compactors.

3. GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS.

3.1 Control. Moisture-density relations shall be established by the Contractor. Field density tests shall be performed by the Contractor in sufficient number and in such locations to insure that the specified density is being obtained. 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.

3.1.1 Laboratory Control. One moisture-density relation shall be made for each classification, blend or change in classification of soil material encountered. Approval of moisture-density relations shall be obtained prior to the compacting of any material in the work. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557 (modified as specified hereinafter).

3.1.1.1 A separate batch of materials will be used for each compaction test specimen. No materials will be re-used.

3.1.1.2 The desired amount of mixing water will be added for each compaction test specimen, mixed well, and the mixture will be placed in a container with an airtight cover and allowed to cure for 24 hours. A shorter curing time may be allowed where tests show that shortening the curing time will not affect the results.

3.1.1.3 A moisture-density relation shall be performed for every tenth field density test. The moisture-density relations shall be determined in a laboratory in accordance with ASTM D 1557 (modified as specified hereinafter).

3.1.1.3.1 Only one compaction test specimen (one-point) will be formed.

3.1.1.3.2 The material used for the compaction test specimen will be no wetter than minus 2 percent of optimum.

3.1.1.3.3 The addition of water and curing for the material will be as specified hereinabove.

3.1.2 Field Control. Field in-place density shall be determined in accordance with ASTM D 1556 and Field Moisture Content shall be determined in accordance with ASTM D 2216. The density tests shall be well distributed and shall average not less than one test for each 4,000 cubic yards of material. At least one test shall be made in each 2 feet of compacted material processed as a unit and at least one test shall be made in each area.

3.1.3 Moisture-Density Curves for Cohesionless and Cohesive Material. Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils may show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.2 Settling of Fills or Backfills with Water will not be permitted, except as specified hereinafter for sand fill, filling voids behind walls, and channel R.C.P. bedding.

3.3 Material shall be selected from the required excavations, shall be free from sod, roots, brush, debris, trash or other objectionable material, and shall contain no stone or blocks of cemented alluvium whose greatest dimension is more than 3/4 of the layer thickness.

3.4 Placement. Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 psi when tested in accordance with the SECTION: CONCRETE. Heavy equipment shall not be operated over pipes and buried structures until at least 2 feet of fill material has been placed and compacted over them in conformance with the requirements of SECTION: SIDE DRAINS. Compacted fill and backfill shall be placed with suitable equipment in horizontal layers which after compaction, shall not exceed 12 inches in depth for rubber-tired or vibratory rollers, 6 inches in depth for tamping rollers, and 4 inches in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids.

3.5 Moisture Content. Material shall have a uniform moisture content while being placed and compacted. Water shall be added at the source, if required, or by sprinkling each layer of material during placement. Uniform distribution of moisture shall be obtained by disking, harrowing, or otherwise manipulating the soil during and after the time water is added. Material containing an excess of moisture shall be manipulated with suitable implements to facilitate maximum aeration and shall be permitted to dry to the proper consistency before being compacted. Fill shall have a maximum moisture content of not more than 3 percent above optimum and a minimum moisture content of not less than 3 percent below optimum.

3.6 Compaction. No layer of fill shall be compacted before the practicable uniform moisture content has been obtained. If the Contractor elects to use rubber-tired or steel drum compaction equipment and the compacted surface of any layer of material is determined by the Contracting Officer to be too smooth to bond properly with succeeding layers, it shall be scarified by a method approved by the Contracting Officer. Scarified areas shall be compacted as specified for the fill placed thereon. Rollers will not be permitted to be operated within one foot of channel or structure walls or over buried structures until the compacted fill over the top of the structures has reached a depth of 2 feet. Compaction equipment shall be so operated that structures are not damaged nor overstressed during compaction operations. Mechanical tampers shall be used for compaction of fill material adjacent to structures where rolling equipment is impracticable for use in compaction.

4. COMPACTED FILL, CHANNEL.

4.1 General.

4.1.1 Material for compacted fill channel shall be obtained from the required excavations as approved by the Contracting Officer. In general, the best material available will be designated as compacted fill, channel. Compacted fill, channel may consist of sand, gravelly sand, silty sands, and clayey sands as determined by ASTM D 2487. Organic material, silt, sandy silt, clay, sandy clay, broken concrete or pavement, stone or blocks of cemented alluvium when the greatest dimension is greater than 3 inches, and other objectionable materials shall not be used. Processing the excavated material to remove the stone or blocks of cemented alluvium whose greater dimension is greater than 3 inches will be required.

4.1.2 Preparation for Placing. Before placing material for compacted fill, the foundation surface shall be cleared of all existing obstructions, vegetation, and debris and proofrolled by 4 passes of the compaction equipment. Unsuitable material not meeting the requirements for fill material, as defined in the above paragraph, shall be removed where directed, and the existing surfaces with the exception of rock and cemented alluval surfaces scarified to a depth of 6 inches before placing the fill. Sloped ground surfaces steeper than one vertical to 4 horizontal, on which fill or compacted backfill is to be placed, shall be stepped in such a manner that the compaction equipment will bear on the full depth of the fill layer.

4.1.3 Compaction. Each layer of the material shall be compacted to not less than 90 percent of maximum density, except for the fill beneath the invert access ramps at Stations 796+94, 861+25, and 952+42. Each layer of the materials beneath the invert access ramps shall be compacted to not less than 95 percent of maximum density as determined by ASTM D 1557. This zone of fill compacted to 95 percent of maximum density beneath the invert access ramps shall extend past the edges of the ramps to planes drawn on a 1V to 1H slope projected from a plan projection of the ramp on the bottom of the excavation or as directed by the Contracting Officer.

4.2 Behind Channel Walls.

4.2.1 Placing. Fill material as defined hereinabove shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 psi when tested in accordance with SECTION: CONCRETE. Backfill pressure behind both walls shall be kept as equal as possible by bringing up the fill behind the walls in equal increments of reasonable height. It is the Contractor's responsibility to assure that the walls do not become misaligned using this method. The concrete invert shall have been in place not less than 7 days, prior to completing backfill at that location. The construction sequence and backfilling operation shall be phased such that any runoff that would pool behind the walls is pumped out or flows freely from behind the walls to preclude saturating the backfill. Backfilling operations for the covered channel section may not commence until the top slab is in place and the 28 day concrete strength has been reached, unless approved by the Contracting Officer.

4.2.2 Limitations on Equipment. The gross weight of any piece of equipment, or the combined weight of any combinations of equipment coupled together, used to place, moisten and/or compact fill behind channel walls shall not exceed 35,000 pounds, including dynamic forces produced by vibratory equipment. Equipment used to compact the fill behind the channel walls shall be of such size as to be capable of operating in the area between the cut slope and the channel wall. Compaction equipment will not be required to operate at elevations lower than 2 feet above the top of the heel of the channel invert.

4.2.3 Compaction. Each layer of fill behind channel walls shall be compacted to not less than 90 percent of maximum density as determined by ASTM D 1557.

5. COMPACTED FILL, BACKFILL TOE. Backfill toe shall consist of material placed over grouted stone protection.

5.1 Compaction. Backfill toe compacted fill shall be placed in 24-inch thick horizontal layers and compacted by 2 passes of the construction equipment and smoothed and dressed to the lines and grades indicated.

6. COMPACTED FILL, LEVEE.

6.1 Materials. Material shall contain at least 15 percent passing.

6.2 Preparation for placing shall conform to the requirements specified for preparation for placing fill material in the paragraph: COMPACTED FILL, CHANNEL.

6.3 Compaction. Each layer of levee fill shall be compacted to not less than 90 percent of maximum density.

7. COMPACTED FILL, SIDE DRAINS. Bedding and backfill for side drains and storm drains shall conform to the requirements of SECTION: SIDE DRAINS.

8. BACKFILLS.

8.1 Backfill and Fill About Structures.

8.1.1 Location. Backfill and fill shall consist of all fill against and/or around structures, except backfill for side drain trenches, compacted fill channel, compacted fill backfill toe, and compacted fill levee.

8.1.2 Material. Backfill and fill material shall be obtained from the required excavation as approved by the Contracting Officer. In general, the best material available will be designated as backfill and fill about structures. Backfill may consist of sand, gravelly sand, silty sands, and clayey sands. Organic material, silt, sandy silts, clay, sandy clays, broken concrete or pavement, stone or blocks of cemented alluvium when the greatest dimension is greater than 3 inches and other objectionable material shall not be used.

8.1.3 Placing. Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 psi when tested in accordance with SECTION: CONCRETE.

8.1.4 Compaction shall be not less than 90 percent of maximum density.

8.2 Backfill, Side Drain Trenches. Backfill for side drains shall conform to the requirements of SECTION: SIDE DRAINS.

9. SUBGRADE PREPARATION.

9.1 Subgrade Preparation (Alluvium-Cemented Alluvium). After the channel has been excavated to rough grade in accordance with SECTION: EXCAVATION, the entire subgrade for the channel invert slab and Cudia City Wash sediment basin spillway shall be proofrolled by 4 passes of the compaction equipment and trimmed to a uniform grade and smoothed with a steel-wheeled roller to make the subgrade ready to receive concrete. If the subgrade is disturbed by the Contractor's operations or is overexcavated, or is soft and yielding the subgrade shall be restored to grade and compacted to a density of 90 percent of maximum density. The finished surface of the subgrade shall not be more than 1/2 inch from the indicated grade at any point when tested with a 10-foot straightedge.

9.2 Subgrade Preparation (Rock).

9.2.1 General. Bedrock surfaces upon or against which structural concrete or backfill materials are to be placed shall be prepared and treated as directed by the Contracting Officer and as specified herein below.

9.2.2 Equipment. Bedrock surfaces shall be cleaned using hand tools. Hand tools, where required or permitted by these specifications, include but are not limited to shovels, bars, picks, wedges, and brooms. Light power tools and rubber tired mechanical equipment may be used only when such use is approved by the Contracting Officer.

9.2.2.1 Air Jets. Air jets may be used only when such use is approved by the Contracting Officer. An air jet shall consist of a minimum one inch nozzle with a supply hose connected to a suitable source of compressed air. The compressed air shall be controllable at the nozzle.

9.2.3 Surface Preparation. When the excavation has reached the approximate limits shown on the drawings, the Contractor shall perform a detailed cleanup of the bedrock surface. The work shall consist of removing loose and/or weathered rock and pockets of fines, sand, rock, rubble or gravel and other objectionable material as directed from the in-place rock surfaces including depressions, large crevices, and open joints and fractures. Picking, barring, and hand excavation may be necessary to obtain a foundation surface free from loose, drummy, or shattered rock. The final rock surface

shall be thoroughly cleaned by the use of hand tools or other approved methods and shall be maintained in a clean condition until the placement of structural concrete or backfill materials thereon.

9.2.4 Surface Treatment. Prior to the placement of structural concrete or backfill materials, all designated bedrock surfaces shall be treated with dental concrete as directed by the Contracting Officer. No dental concrete shall be placed until the foundation cleanup is approved by the Contracting Officer. No structural concrete or backfill materials shall be placed until all dental concrete has had a minimum of 2 days to cure.

9.2.4.1 Dental Concrete. Dental concrete shall be used to fill joints, cavities, and depressions. Prior to placement of dental concrete, the designated areas for placement shall be thoroughly cleaned using approved methods. The designated areas shall be moistened such that absorption of water from the dental concrete will be minimized, however, no standing water will be allowed. Immediately after placement, the dental concrete shall be vibrated as specified in the SECTION: CONCRETE and screen tamped to provide a rough surface texture. The edges of all dental concrete areas shall then be trimmed, as required, so that no thin coats of concrete are left on smooth, intact rock surfaces. Concrete, including any forming required for acceptable placement, shall conform to the applicable requirements of the SECTIONS: CONCRETE and FORMWORK FOR CONCRETE.

9.2.5 Foundation Approval. No structural concrete or backfill materials shall be placed on any part of the bedrock foundation until all foundation preparation and treatment has been completed and such areas have been inspected and approved by the Contracting Officer. The Contractor shall remove, at his own expense, any backfill material or structural concrete placed on any part of the bedrock foundation surface which has not been approved by the Contracting Officer and shall reclean such areas at his own expense to the satisfaction of the Contracting Officer. Areas approved for material or concrete placement which have been exposed for more than 5 days may require re-cleaning at no additional expense to the Government. Areas approved for immediate material or concrete placement shall then be moistened as directed. Foundation approval shall be done in sections, the limits of which shall be established by the Contracting Officer in the field.

9.3 Subgrade Preparation for Spillway, Road Pavement, Curbs and Driveways. 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 4 inches in diameter, and hard ribs of earth shall be removed and the subgrade shall be compacted to not less than 95 percent maximum density. Following the above operations, the subgrade shall be shaped to a true cross section sufficiently higher than the specified grade to allow for subsequent compaction and then be thoroughly compacted to not less than 95 percent of maximum density as determined by ASTM D 1557. After the subgrade has been prepared and completed, the surface shall be firm, hard, and unyielding, with a true, even and uniform surface conforming to the grade and cross section indicated on the drawings. All points of the finished subgrade shall be not more than 1/4 inch below or above true subgrade. Subgrades on rock shall be prepared as specified in paragraph: SUBGRADE PREPARATION.

10. MISCELLANEOUS FILL. Miscellaneous fill shall consist of material from the required excavation, placed in the area indicated and shall be placed with suitable equipment in layers which shall not exceed 24 inches in depth before consolidation. No depressions in which water might pond shall be left in miscellaneous fill areas. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required. Broken concrete, rock, bituminous paving and other objectionable material shall not be used.

11. OPTIONAL DISPOSAL AREAS. Fill to be placed in the optional disposal areas shall consist of material from the required excavation.

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SECTION 2E

PRIME COAT AND WEED KILLER

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 American Society for Testing and Materials (ASTM).

ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 2027	(1976; R 1986) Cutback 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 have been 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.

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 of the Contracting Officer.

6.2 Bituminous Distributor shall have pneumatic tires of such width and number that the load produced on the base surface shall not exceed 650 pounds per inch of tire width. The distributor shall be designed and equipped to distribute the bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard with a pressure range of 25 to 75 pounds per square inch and with an allowable variation not to exceed 5 percent from any specified rate. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure 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 unavoidably 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 substance shall be removed from the surface by means of a power broom or blower supplemented with hand brooms. After the cleaning operation and prior to the application of the 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. The proposed weed killer, application methods and rates shall be submitted to the Contracting Officer for approval.

9. APPLICATION OF BITUMINOUS MATERIAL. Immediately following the preparation of the surface, the bituminous material 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 can be started and stopped

on the paper, and all sprayers operate at full force on the surface to be treated. Immediately after the application, building paper shall be removed from the site by the Contractor. 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 centistrokes, 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.

10. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets shall be submitted during the progress of the work. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified weigh bills and/or certified delivery tickets for all bituminous material actually used in the construction of pavement covered by this section of the specification.

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SECTION 2F

ASPHALT CONCRETE

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 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO M 226	(1980; R 1986) Viscosity Graded Asphalt Cement

1.2 American Society for Testing and Materials (ASTM).

ASTM C 117	(1987) Materials Finer Than No. 200 (75um) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1988) Specific Gravity and Absorption of Fine Aggregate
ASTM C 136	(1984a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 140	(1988) Sampling Bituminous Materials
ASTM D 242	(1985) Mineral Filler for Bituminous Paving Mixtures
ASTM D 977	(1986) Emulsified Asphalt
ASTM D 1559	(1982) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

1.3 Military Standard.

MIL-STD-620	(Rev A; 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 M 226, viscosity grade AR-40 or AR-80, Table 3.

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

5. SAMPLING AND TESTING.

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

5.2 Quality Control 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 gradation 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.

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
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. 30	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 shall be between 5.5 percent and 6.5 percent.

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 Retained Stability. 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:

a. Addition of heat-stable additives to bitumen.

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

9.4 Small Tools available at the site of the work shall consist of the following: rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters 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 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 p.s.i. Construction of the roller shall be such that each wheel can be loaded to a minimum of 4,500 pounds.

9.7 All equipment, tools and machines used in the performance of work specified herein shall be subject to approval and shall be maintained in satisfactory working conditions.

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 it's 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 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, shall be determined by the Contractor and approved by the Contracting Officer.

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, 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 assure 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 at a temperature 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 uniform distribution is obtained over all points of the surface to be treated. Lightly coated areas and spots missed 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. The Contractor shall furnish and spread a sufficient quantity of clean, dry sand on all areas that show an excess of bituminous material, to effectively blot up and cure the excess when directed by the Contracting Officer. The treated surface shall be maintained by the Contractor until the succeeding layer of pavement has been placed. During this interval the Contractor shall protect the treated surface against damage and shall repair all damaged spots at no additional cost to the Government.

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 pavements 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 1/4 inch less than the thickness specified on the drawings. If the pavement is more than 1/4 inch deficient in thickness, the Contractor shall either (1) remove the entire pavement thickness and replace it or (2) overlay the pavement to bring it to the specified thickness. If

the Contractor elects to overlay the pavement he will submit a new mix design to the Contracting Officer. This mix design will utilize a maximum nominal aggregate size of 1/4 inch and shall supply the same properties as listed under paragraph: TEST PROPERTIES OF BITUMINOUS MIXTURES, as the original mixture proposed. This mix design shall be subject to all approvals and requirements of other bituminous mixtures as stated above. No payment will be made for excessive thickness.

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. SAMPLING. Sampling for the determination of thickness and density of the completed pavements will be performed by the Contracting Officer. All other tests necessary to determine conformance with the specified requirements will be performed by the Contractor. The Contractor shall replace the pavement where samples are removed, at his expense. No payment will be made for areas of pavement deficient in composition, density, or thickness until they are removed and replaced by the Contractor as directed by the Contracting Officer.

19. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills 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 weigh bills and/or certified delivery tickets for all material used in the construction of the pavement covered by this section of the specifications.

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SECTION 2G

AGGREGATE BASE

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 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO T 180	(1986) Moisture-Density Relations of Soils Using a 10-lb (4.54 Kg) Rammer and an 18-in. (457 mm) Drop

1.2 American Society for Testing and Materials (ASTM).

ASTM C 117	(1987) Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1988) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1981; R 1987) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1984a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987) Sampling Aggregates
ASTM D 422	(1963; R 1972) Particle-Size Analysis of Soils
ASTM D 1556	(1982) Density of Soil In Place by the Sand-Cone Method

ASTM D 1557	(1978) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.5-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2216	(1980) Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1987) Wire-Cloth Sieves for Testing Purposes

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
1-1/8 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 Field 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 or AASHTO T 180.

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 the 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 Contractor shall give the Contracting Officer a 24 hour notice to inspect the subgrade before aggregate base course is placed. The subgrade shall conform to SECTION: FILLS AND SUBGRADE PREPARATION. 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 or 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 on the drawings. 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. Water content shall be maintained at optimum plus or minus 2 percent. 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 placed materials shall be reworked until they are a satisfactory material. When materials become damaged during placing they shall be removed from the work and disposed of as directed by the Contracting Officer.

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, or when the course is being constructed in two layers, to the thickness of each layer of the course. Allow in each operation at least a 1-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 either a 10- or 12-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.

16. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets shall be attached to the Daily Contractor Quality Control Report for the day of delivery. Before the final statement is allowed, the Contractor shall file with the Contracting Officer weigh bills and/or certified delivery tickets for all aggregates actually used in the construction covered by the contract.

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SECTION 2H

MISCELLANEOUS AGGREGATES

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 C 33	(1986) Concrete Aggregates
ASTM C 131	(1981; R 1987) Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 144	(1987) Aggregate for Masonry Mortar

2. DESERT GRAVEL. Desert gravel (DG) shall be placed as indicated on the drawings and shall match desert gravel previously placed in Arizona Canal Diversion Channel area from 29th Avenue to 47th Avenue. In the event that the Contractor can not match the existing area, desert gravel shall be placed in accordance with the following requirements:

2.1 Desert Gravel shall be any granitoid igneous rock which has been weathered, in place, and which has as its principal constituents granular fragments of quartz and feldspar. Desert Gravel may also contain fragments of granite rock not yet broken down into the component minerals. The material shall remain stable when saturated with water.

2.2 Material shall be free from all foreign objects, lumps, irregularities, and shall be consistent in color.

2.3 Desert gravel shall have a maximum size of not more than 1/2 inch, not less than 35 nor more than 60 percent passing the number 4 seive, not more than 15 percent of the material passing the No. 200 sieve, and shall have a plasticity index of less than 10 for the materials passing the No. 40 sieve.

2.4 Color shall conform to the Munsell Soil Color Chart (1975 edition; published by the Kollmorgen Corp., 2441 North Calvert Street, Baltimore, Maryland 21218). Color shall by light brown, 7.5YR 6/4.

2.5 Material shall be obtained from commercial sources.

2.6 The Contractor shall submit 1 pound sample of DG to the Contracting Officer for approval prior to placement.

2.7 DG shall be spread to a depth of 2 inches, raked, dampened, and rolled with a 90 pound roller.

2.8 Preparation of Subgrade. Prior to placing the desert gravel surfacing the subgrade shall be cleaned of all foreign substances. Ruts or soft, yeilding spots that may appear in the subgrade; areas having inadequate compaction; and deviations of the surface from requirements set forth herein shall be corrected by loosening, removing, and adding approved material, reshaping to line and grade, and recompacting to specified density requirements.

3. LANDSCAPE MOUNDING. Fill material for use in landscape mounding shall be representative of existing site soil and be free of all foreign material, unsuitable material such as caliche, and all organic material and stones larger than 2 inches in diameter. Fill for landscape mounding shall be the Contractor's responsibility and shall be subject to approval by the Contracting Officer.

4. PEA GRAVEL. Aggregate for "pea gravel" shall be clean sand, gravel, or crushed rock, shall be free from lumps or balls of clay, and shall not contain calcareous or clay coatings, caliche, synthetic materials, organic matter or foreign substances. The gradation shall meet the following requirements:

Sieve Size	Percent Passing
3/8 inch	100
No. 4	0-25
No. 8	0-5
No. 200	0-2.0

5. HERBICIDE. Areas to be covered with desert gravel or paving stones shall be treated with a commercial pre-emergent herbicide such as Dacthol, or approved equal. The herbicide shall be applied at the manufacturer's maximum recommended rates for pre-emergent herbicides. The subgrade shall be thoroughly compacted and the area to be treated shall be free of weeds immediately prior to application of herbicide. The herbicide shall be applied in a slurry mixture through a 50 mesh screen. Herbicide shall be applied in a manner which precludes contact with existing plant materials. The herbicide shall be applied in two applications. The first application shall be made immediately prior to installation of desert gravel. The second application shall be made immediately following installation of the desert gravel.

6. BOULDERS. Boulders shall be approximately cubical, quarried stone, with a minimum size of 36 inches by 36 inches and shall be subject to the approval of the Contracting Officer. The gradation shall be as indicated on the drawings. Boulders which have been scarred during transportation, loading, or unloading will be rejected and shall be removed from the site at no additional cost.

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SECTION 2I

TREES, SHRUBS, AND GROUND COVERS

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 American Joint Committee on Horticultural Nomenclature (AJCHN).

AJCHN-01 (1942; 2nd Ed) Standarized Plant Names

1.2 American National Standards Institute (ANSI).

ANSI Z60.1 (1986) Nursery Stock

1.3 Federal Specification (FS).

FS O-F-241 (Rev D) Fertilizers, Mixed, Commercial

2. SOURCE INSPECTIONS.

2.1 Plant Materials. Plant materials will be inspected by the Contracting Officer at the growing site and tagged or otherwise approved for delivery. Such inspection does not preclude right of rejection at the project site.

2.2 Topsoil. The source of topsoil will be inspected by the Contracting Officer to determine the acceptability of the topsoil and the depth to which it is to be stripped.

3. SUBMITTALS.

3.1 Samples. The following samples shall be submitted for approval before work is started.

a. Topsoil. Representative samples shall be taken from several locations on the area under consideration.

b. Soil Amendments. Ten pounds of each type to be used in the project.

c. Erosion control material. One six inch square including manufacturer's written installation instructions and descriptive brochure.

3.2 Certified Laboratory Test Reports. Testing shall be performed by an approved independent laboratory within 10 days of submittal of reports. Test reports on a previously tested material shall be accompanied by certificates from the manufacturer certifying that the material is equal in all respects to that proposed for this project. Certified copies of the reports of tests listed below shall be submitted:

a. Offsite topsoil - for pH, salts, potash, and phosphorous.

b. Organic Amendments - for classification of total nitrogen, moisture ash and organic matter, sand content, pH.

3.3 Certificates of Conformance or Compliance. Before delivery, notarized certificates attesting that the following materials meet the requirements specified, shall be submitted for approval and in accordance with SPECIAL CLAUSES.

a. Plant materials.

b. Fertilizers.

c. Herbicide.

d. Desert gravel.

e. Pesticides.

f. Soil conditioners.

g. Top soil.

3.4 Maintenance Instruction. Written instructions for year-round care of installed plants shall be furnished.

3.5 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 plant name and size.

4. DELIVERY, STORAGE, AND HANDLING.

4.1 Delivery.

4.1.1 The Contractor shall notify the Contracting Officer of the delivery schedule in advance so the plant material may be inspected upon arrival at the jobsite by the Contracting Officer. Unacceptable plant material shall be removed from the jobsite immediately.

4.1.2 Plants shall be protected during delivery and transportation 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 Fertilizer shall be delivered to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, name, trade name or trademark, and in conformance to state and Federal law. In lieu of containers, fertilizer may be furnished in bulk and a certificate 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.

4.1.5 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.

4.2 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 stored on the project shall be protected from any drying at all times. Plants in containers, shall be kept in a moist condition until planted by routine watering.

4.2.2 Storage of Other 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 damaging plants being moved from the nursery or storage area to the planting site. Plants shall be protected from freezing or drying out by covering with burlap, tarpaulin or mulching material during transporation to planting site. Plants shall not be handled by the trunk or stems. Damaged plants will be rejected and shall be removed from the site.

5. ENVIRONMENTAL PROTECTION. All work and Contractor operations shall comply with the requirements of SECTION: ENVIRONMENTAL PROTECTION.

6. MATERIALS.

6.1 Plants.

6.1.1 Plants shall conform to the varieties specified in the plant list and be true to botanical names as listed in AJCHN-01. Plants shall be in accordance with ANSI Z60.1 except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specifications shall prevail.

6.1.2 Planting stock shall be well-branched and well-formed, sound, vigorous, healthy, and free from disease, sun-scald, windburn, abrasion, and harmful insects or insects eggs and shall have healthy, normal and unbroken root systems. Deciduous trees and shrubs shall be symmetrically developed, of uniform habit of growth, and free from objectionable disfigurements. Plants shall have been grown under climatic conditions similar to those in the locality of the project.

6.1.3 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 with the approval of the Contracting Officer with no change in the contract price. If larger plants are used, the ball of earth or spread of roots shall be increased in accordance with ANSI Z60.1.

6.1.4 The Contractor shall facilitate inspection and identifications by labeling trees or containers of the same shrub, with a durable waterproof label and weather-resistant ink. Labels shall state the correct plant name and size as specified in the list of required plants. Labels shall be securely attached to plants and shall be legible for the duration of the plant establishment period.

6.1.5 Plant material shall be nursery grown unless otherwise indicated and shall conform to the requirements and recommendations of ANSI Z60.1. Plants shall be prepared for shipment in a manner that will not cause damage to branches, shape, and future development after planting.

6.1.5.1 Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers but shall not be root bound. Container shall be free from noxious weeds.

6.1.6 Substitutions shall be made only when a plant (or its alternates as specified) is not obtainable and the Contracting Officer authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential charateristics with an equitable adjustment of the contract price.

6.2 Topsoil.

6.2.1 Topsoil shall be the existing surface soil stripped and stockpiled on the site after the project site has been cleared and grubbed. The soil shall be free from nut grass, refuse, heavy clay, noxious weeds or any material toxic to plant growth.

6.2.2 Additional topsoil, if required, beyond that available from stripping operations, shall be 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 7.0 to 7.5. Topsoil that does not meet the pH range shall be amended by the addition of pH adjusters, at a rate recommended by the County Extension Service agent, based on soil tests.

6.3 Soil Conditioners and Amendments.

6.3.1 Rotted sawdust 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.

6.3.2 Planting Soil Mixture. The planting soil mixture shall be composed of six parts topsoil, and four part rotted sawdust, two lbs. iron sulphate per cubic yard of mix and fertilizer tablets at the manufacturer's recommended rate.

6.4 Fertilizer. Fertilizer shall be commercial grade and uniform in composition.

6.4.1 Tablet form of slow release fertilizers shall be used conforming to FS O-F-241 with IBDU (isobutylidene-diurea), and shall bear the manufacturer's guaranteed statement of analysis. Slow release fertilizers shall contain a minimum percentage by weight of: 14 nitrogen, 3 percent available phosphoric acid, and 3 percent potash.

6.5 Mulch. Mulch shall be 2 inch D.G. free from deleterious materials and shall be stored so as to prevent inclusion of foreign materials.

6.6 Staking Material.

6.6.1 Stakes for support shall be lodge pole pine, free from knots, rot, cross grain, or other defects that would impair the strength. Standard stakes shall be treated with pentachlorophenol, and 2-1/2 inches in diameter by 8 feet long and pointed at one end shall be used. Ground stakes shall be a minimum of 2 inches by 2 inches and 3 feet long and pointed at one end.

6.6.2 Tie wire shall be 12 gauge annealed galvanized steel.

6.6.3 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.

6.7 Water. Water shall not contain elements toxic to plant life.

6.8 Erosion control material shall be SC 150, combination straw and coconut fiber erosion control blanket, netted on both sides, manufactured by North American Green, Inc., 14649 Highway 41 North, Evansville, Indiana 47111, or an approved equal. Erosion control material shall be installed in accordance with manufacturer's instructions.

7. SITE PREPARATION.

7.1 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.

7.2 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.

7.3 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.

7.4 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.

7.5 Plant Pits. Plants 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 shown on the drawings.

7.6 Herbicide and Pesticide Application. Herbicides, insecticides and fungicides shall be applied as needed and in accordance with the manufacturer's recommendations.

8. INSTALLATION.

8.1 Planting Seasons and Conditions. Planting shall not be done when the ground is in an unsuitable condition for planting as determined by the Contracting Officer.

8.2 Container grown stock shall be removed from containers in such a way so as to prevent damage to plant or root system. Planting shall be completed as specified above.

8.2.1 Container stock shall be backfilled with topsoil to approximately half the depth of the ball and then tamped and watered. The remainder of backfill of topsoil shall be tamped and watered. Earth saucers or water basins shall then be formed around isolated plants. Water holding basins shall be ample enough in size and height to hold at least 2-1/2 gallons for shrubs or 5 gallons for trees.

8.3 Watering. Depressed water basins shall be used around all plants. All watering shall be done in a manner which will provide deep penetration, 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 24 inches. Frequent watering may be necessary during periods of hot weather.

8.4 Inspection. The trunks of the trees shall be inspected for physical damage or insect infestation and required treatment or rejection shall be determined.

9. PRUNING.

9.1 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. 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 insure 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. Trimmings shall be removed from the site. Cuts 1/2 inch in diameter and larger shall be painted with the specified tree wound dressing.

9.2 Restoration and Clean-Up. Excess and waste material shall be removed daily. When planting in an area has been completed, they shall be cleared of all debris, spoil piles, and containers.

9.3 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 by the Contractor during the installation period and needed maintenance performed promptly.

10. PLANT ESTABLISHMENT PERIOD. Final acceptance of all work and materials under this section shall be at the end of a period of establishment to be determined as follows.

10.1 Beginning of the Plant Establishment Period. The period of establishment shall begin on the date that an inspection by the Contracting Officer shows that all plants are in place and have been installed in accordance with the specifications and plans. Replacement of plants that were not supplied by the Contractor but were relocated under this contract and that die for any reason other than improper handling during transplanting and/or lack of proper care will not be required. Loss through Contractor negligence, however, shall require replacement in kind and size per specification and shall be at the Contractor's expense.

10.2 During the Plant Establishment Period.

10.2.1 During the plant establishment period, the Contractor shall water all plants as necessary to maintain an adequate supply of moisture within the root zone. Water shall not be applied so quickly that it cannot be absorbed by the plants. The Contractor shall be responsible for providing necessary water during the plant establishment period.

10.2.2 Plants shall be pruned as required.

10.2.3 Stakes and eroded plant saucers shall be replaced as required.

10.2.4 Other work, such as spraying with approved insecticides and fungicides to control pests, shall be done (each day if necessary) to ensure plant survival in a healthy growing condition.

10.2.5 Dead plants shall be removed immediately at the Contractor's expense and replaced within seven (7) days. The Contractor will be responsible for theft or damage to plants by vehicles or vandalism until final project completion, approval, and acceptance of the planting contract.

10.3 Termination of the Plant Establishment Period.

10.3.1 A preliminary inspection by the Contractor and the Contracting Officer will be held 120 days from the date of the beginning of the plant establishment period to determine plant acceptability and the number of replacements. Alternate or substituted varieties of plants shall be used only if approved by the Contracting Officer.

10.3.2 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. The establishment period will end on the date of this inspection and said inspection will be considered final acceptance provided the Contractor has complied with the following requirements.

a. Dead, missing, and defective plant material shall have been replaced as directed by the Contracting Officer otherwise, final acceptance will be delayed until such replacements have been satisfactorily accomplished.

b. Plant saucers shall be free of weeds.

c. Stakes and guys shall be in good condition.

d. Remedial measures directed by the Contracting Officer to ensure plant survival shall have been carried out.

e. Plant material shall have been fertilized as required prior to acceptance.

11. MAINTAINING EXISTING TREES.

11.1 Existing trees which fall outside of the limits of excavation and within the right-of-way, and which have been marked for saving, shall be protected and maintained during the life of the contract as directed by the Contracting Officer.

11.2 Maintenance operations shall begin immediately after the Contractor has begun work and shall continue until 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.

11.3 Pruning shall be accomplished in the following manner. Dead and broken branches shall be removed. Trees shall be pruned to reduce total anticipated foliage by one fourth. Typical growth habits 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 insure elimination of stubs. "Headback" cuts at right angles to line of growth shall not be permitted. Trimmings shall be removed from the site. Cuts 1/2 inch in diameter and larger shall be painted with the specified tree wound dressing.

* * * * *

SECTION 2J

IRRIGATION SYSTEM

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 American National Standards Institute, Inc. (ANSI).

ANSI B16.26	(1983) Cast Copper Alloy Fittings for Flared Copper Tubes

1.2 American Society for Testing and Materials (ASTM).

ASTM A 120	(1984) Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
ASTM B 88	(1988a) Seamless Copper Water Tube
ASTM D 1785	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1988) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1988) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1988) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

1.3 American Water Works Association (AWWA) Standards.

AWWA C 651	(1986) Disinfecting Water Mains

1.4 Federal Specification (FS).

FS WW-V-54	(Rev D; Int. Am-3) Valve, Gate, Bronze (125, 150 and 200 Pound, Threaded Ends, Flange Ends, Solder End and Brazed Ends, for Land Use)

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

MSS SP-58	(1983) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1983) Pipe Hangers and Supports - Selection and Application

2. GENERAL. This section covers irrigation piping including connection to source of water supply, complete.

2.1 Above ground piping shall be copper tubing or as shown on the drawings.

2.2 Below Ground Piping. Pipe below ground shall be plastic. Pipe for sleeving shall be corrugated metal, galvanized steel or plastic. The minimum cover for laterals shall be 12 inches and 4 inches for dripline, unless otherwise indicated on drawings. The minimum cover for pressure lines shall be 2.5 feet except under roadways, parking and paved areas where the minimum cover shall be 3 feet. The electric wire conduit may be placed above the main line in the same trench. All other irrigation lines and wire shall be placed as shown on the drawings.

2.3 Electrical Work from power source to automatic controllers shall conform to the applicable requirements of SECTION: ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.4 Sprinkler heads and control valves shall not be located within 18 inches of buildings or structure foundations.

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 requirements of paragraph: PIPE BEDDING AND BACKFILL MATERIALS 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 exavations, and any water accumulating therein shall be removed by pumping or by other approved methods. Sheeting 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. Trench excavation shall follow, as much as possible, layout indicated on drawing. 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 overexcavate. 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. 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.

3.3 Jobsite Conditions.

3.3.1 Protection of Property. The Contractor shall be responsible for the preservation and protection of all trees, plants, monuments, structures and paved areas from damage due to this work. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to the satisfaction of the Contracting Officer, and all injury to living plants shall be repaired by the Owner or such persons as he may employ to accomplish this work. All the costs of such work shall be charged to and paid by the Contractor. Open ditches left exposed shall be flared and barricaded by the Contractor. Damage caused by the Contractor to asphalt, concrete or other building material surfaces shall be repaired or replaced by the Contractor at his expense. Contractor shall restore disturbed areas to original condition.

3.3.2 Existing and New Plantings. All trenching or other work under the limb spread of any and all evergreens or low branching deciduous material shall be done by hand or by other methods so that no limbs or branches are damaged in any way. Where it is necessary to excavate adjacent to existing trees, use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2 inch and larger roots occur, shall be done by hand. Roots 2 inch or larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Where a trenching machine is operated close to trees having roots smaller than 2 inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed making clean cuts through roots. One inch and larger in diameter roots shall be painted with two coats of "tree seal" or accepted equivalent. Trenches adjacent to trees should be closed within 24 hours, and where this is not possible, the side of the trench adjacent to the tree shall be kept shaded with wetted burlap or canvas.

3.3.3 Protection and Repair of Underground Lines. The Contractor shall be responsible for requesting the proper utility company to stake the exact location of any underground electric, gas and telephone lines. The Contractor shall take whatever precautions are necessary to protect underground lines from damage, and in the event damage does occur, all damage shall be repaired by the Owner or such persons as he may employ to accomplish this work. All costs of such work shall be paid by the Contractor unless other arrangements have been made.

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 paragraph: PIPE BEDDING AND BACKFILL MATERIALS. After the main irrigation lines have been installed, tested, and approved, 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 6 inches of backfill placed over it and settled with water. The lateral lines shall be installed and backfill placed in the trench and compacted to 90 percent of maximum density with mechanical tampers or vibrators. When no lateral lines are to

be installed, backfill shall be placed in maximum 12-inch lifts and compacted to 90 percent of maximum density with mechanical tampers or vibrators to match lines and grades.

5. MATERIALS. All mainline, (pressure) mainline fittings, and mainline appurtenances (valves, etc.) shall be minimum 200 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 Tubing: ASTM B-88, Type K, annealed.

5.1.3 Plastic Pipe shall conform to ASTM D 1785, schedule 40 for pipe with solvent welded joints and schedule 80 for pipe with threaded joints, or to ASTM D 2241, Type 1, grade 1, 315 psi for pressure lines and 200 psi for other lines for pipe with solvent welded joints. Pipe and fittings shall bear the seal of approval (nsf mark) of the National Sanitation Foundation's standard for plastic pipe and fittings for potable water service. Plastic pipe stored on the construction site shall be protected from sunlight and from dirt entering pipe.

5.1.4 Polyethylene pipe shall be 100 percent polyethylene as follows:

1/2" I.D. .574" wall thickness .050"
Melting point- .065 grams per 10 minutes
Plastic Recovery- 30%
Tensile strength at break- 1665 pounds per square inch
Elongation- 65%
Brittleness at 76°C- zero failures from 10 samples
Stress crack in 100% Igepol solution- zero failures from 10 samples

5.1.5 Polyethylene pipe (dripline) shall have a maximum length of 250 feet in areas containing ground covers, shrubs, and trees. Driplines located in areas containing only shrubs and trees shall have a maximum length of 400 feet, including drip lines rings around shrubs and trees. 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. 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.

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

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

5.3 Fittings and Specials.

5.3.1 For Galvanized Steel Pipe. Steel fittings shall be galvanized. Threaded fittings shall conform to ANSI B 16.3.

5.3.2 For Plastic Pipe. Fittings shall conform to ASTM D 2464 or ASTM D 2466.

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

5.4 Gate Valves shall be designed for a working pressure of not less than 200 psig. 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 the opening.

5.4.1 Valves smaller than 3 inches shall be all bronze and shall conform to FS WW-V-54, Type I.

5.4.2 Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500.

5.5 Backflow Prevention Units.

5.5.1 General. Backflow prevention units of the types indicated shall be installed at the locations shown on the drawings. Where union connections are not provided as part of the unit, the Contractor shall provide and install a union or sleeve type coupling between the control valve and the inlet side of the unit. Pipe and fittings for backflow prevention units shall be bronze or copper.

5.5.2 Reduced Pressure Backflow Prevention Unit. The reduced pressure 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 125 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.

5.6 Emitters (Drip Line). Emitters shall be independent pressure compensating plastic in-line emitters, (Drip Line) capable of providing a consistent discharge rate of one gallon per hour (gph) at 3 to 60 pounds per square inch (psi). The emitter shall be constructed of heat resistant plastic and have an operating range of 3 to 60 pounds per square inch. Emitters shall be spaced as shown on plans.

5.7 Valve boxes shall be plastic or concrete except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Concrete boxes shall be the standard product of manufacturer of precase concrete equipment. The words "Irrigate", for gate valves; and "RCV" for remote control valves shall be cast in covers of boxes for the irrigation system. Plastic boxes shall be a standard catalog product of a manufacturer regularly engaged in the manufacture of valve boxes. Valve boxes 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	Value
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

5.7.1 Install one valve box for each type of valve installed as per details. No valve box extensions will be accepted. Gravel sump shall be installed after compaction of all trenches. Final portion of gravel shall be placed inside valve box after valve box is backfilled and compacted. Controller letter and station number are to be branded on the lid of each valve box. Letter and number size to be no smaller than one inch and no greater in size than 1-1/2 inch, depth of branding to be no more than 1/8 inch and no less than 1/16 inch into valve box lid. Splice boxes shall be labeled with the words "low voltage electrical splice" in the same manner.

5.8 Remote Control Valves and Valve Accessories.

5.8.1 The remote control valves shall be an electrical actuated valve constructed of corrosion-resistant materials. The valve shall have an internal manual operation which allows the opening and closing of the valve without electrical power, or external bleed of water. The valve shall have a self-cleaning screen and a removeable housing cover for easy inline maintenance. The master remote control valve shall be brass; size and type as indicated on the drawings. Other remote control valves shall be as follows:

Materials:	body	-	glass reinforced nylon.
	diaphragm	-	reinforced nylon with O-ring and stainless steel pressure plate.
	spring	-	stainless steel.

Performance:	1"	valve	- min.	2 gpm	max.	50 gpm
(flow rates)	1-1/2"	valve	- min.	10 gpm	max.	110 gpm
	2"	valve	- min.	25 gpm	max.	200 gpm

5.8.2 The solenoid actuator shall be 24 volt A.C. 2-way type. Inrush and holding current shall be no more than 300 mA and 200 mA respectively. The solenoid shall require approximately 1/3 the inrush current as standard 24 volt A.C. solenoids.

Materials:	Plunger and core	-	stainless steel.
	housing	-	glass reinforced nylon, epoxy potted.
	spring	-	stainless steel.

Performance: min. operating voltage at 150 psi shall be 20 volts.
Inrush Current (amps) .104
Holding Current (amps) .104

5.8.3 Automatic Controllers. Connections to items in the field unit enclosure are as follows: Drip valves are to be connected to field unit through output terminals in the order shown on plans. Tennsiometers are to be connected to hydrovisor bus and field unit as per detail. Surge protection is to be wired as detailed. Pressure control to be wired to one of the fourteen input terminals on field unit. Motorized ball valve to be wired to two of the fourteen input terminals. One for opening the valve and one for closing the valve. Total of two valves and four input terminals per point of connection. Flow meter is to be connected to the flow monitor which is

connected to one of the fourteen back indication on the field unit. Radio interface to be connected to field unit in enclosure and antenna mounted outside of enclosure or as detailed on the project drawings. All wiring above grade to be installed in fiberglass reinforced expoxy electrical conduit and as per local code.

5.9 Fertilizer Injector shall be a feeder, water operated, positive displacement proportioning chemical metering pump. The pump shall come with plastic tubing, foot valve strainer, suction valve and discharge valve. The pump minimum operating pressure (line pressure) shall be 15 psig and the maximum operating pressure shall be 125 psig. The fertilizer injector shall have a chemical to water feed ratio of 1:640 gpm maximum. The fertilizer injector shall have the following options:

Diaphragm - Hypalon
Head - PVC
Valve - Double
Single Head Fittings - Universal Injector

The Contractor shall install the fertilizer injector according to the manufacturers requirements and as shown on the drawings.

5.10 Tensiometer shall be solid state maintenance free units, which will react to changes in soil matric 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 matric potential. The Contractor shall install the tensiometers according to the manufacturer's requirements and as shown on the drawings.

5.11 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.

5.11.1 Filter Housing shall be constructed of ten gauge 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 gauges.

5.11.2 Filter Screen shall be 150/mesh stainless steel.

5.11.3 Filter Flush Valve shall be a "ball" type made of brass.

5.12 Irrigation Filter (lateral line) shall be a wye type filter with a 150/mesh screen or smaller. The filter shall be constructed of brass, threaded at both ends and come with a "ball" type flush valve connection.

5.13 Pressure Regulator shall be constructed of brass with double unions (or as shown on the drawings). The pressure regulator shall have integral pressure adjustments and an integral pressure gauge reading to 60 psi. The pressure regulator shall be installed according to the manufacturer's requirements and as shown on the drawings.

5.14 Automatic Irrigation Controller shall be a computer-controlled field satellite system capable of radio communication with a remote (off site) central computer. The irrigation controller shall be multiwired, stand-alone microprocessor base capable

of performing up to eight independent irrigation functions simultaneously. The controller shall be connected by communication cable to the transmitter/receiver unit as shown on the drawings. The minimum station capacity shall be as indicated on the drawings. The irrigation controller shall be mounted in a metal enclosure as specified, detailed and shown on the drawings.

5.15 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.

5.15.1 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.

5.15.2 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.

5.15.3 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.

5.15.4 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.

5.15.5 AC Power Adapter (transformer) shall be UL approved 120 VAC outlet plug-in power supply to provide 12 VDC to the flow monitor.

5.15.6 Field Satellite Tranceiver 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 a microprocessor control, audible status tones, and system privacy for efficient communication on 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 manufacturers recommendation and as shown on the drawings.

5.16 Flow Sensor (meter) shall be a 6-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 and a flow range of 1-30 feet/second. The Contractor shall install the flow sensor according to the manufacturers requirements and as shown on the project drawings.

5.17 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 National Standard pipe thread of the pipe riser size or sizes shown on the drawings. 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 and hose swivels for operating the valves (total of six).

5.18 Vent (air) Valve/Vacuum Breaker shall be for use on an irrigation piping system that will 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 in accordance with manufacturer's written instructions in a 10-inch diameter valve box with boltable cover. A 1/2-inch air vent shall be installed on the high point of each lateral line serving drip irrigation systems.

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 psig
proof pressure 150 psig, minimum

5.19 Gravel shall be pea gravel as indicated on the drawings.

5.20 Pipe Bedding and Backfill Materials. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length. Backfill material shall be screened to remove any stone larger than one inch and may consist of sand, gravelly sands, silty sands, and clayey sands. Organic material, trash, debris, silt, sandy silt, clay, sandy clay, broken concrete or pavement and other objectionable material shall not be used.

5.21 Pipe Straps shall conform to the applicable requirements of MSS SP-58 and MSS SP-69.

5.22 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 manufacturers requirements and as shown on the project drawings.

5.22.1 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) 115 VAC - .46
Options - 2 additional micro-switches
Travel Stops - Stops for 90 degree operation

5.22.2 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.

5.23 Enclosure Box Irrigation Controller shall be a NEMA 4, 12 gauge steel, all welded enclosure 36"(W) x 18"(D) x 48"(H) in height, 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.

5.24 Pressure Sensor (switch) shall be operated by a brass Bourdon tube actuating a mercury switch and enclosed 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.

5.25 Self flushing end valves with concrete or plastic boxes with locking lids, shall be provided at dead ends of all lateral lines and drip line runs of drip system. Each dripline run shall be capable of delivering a minimum of 17 GPH to the flushing valve.

6. INSTALLATION.

6.1 General. Unless otherwise specified, installation of emitters, backflow prevention units, control valves, meters and boxes shall conform to the standard details shown on drawing.

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 prior to jointing.

6.4 Placing and Laying. Pipe, dripline, and accessories shall be carefully lowered in to 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 or 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 or left unattended, open ends of pipe, dripline, fitting, and valves shall be securely closed (water tight) so that no trench water, earth, or other substance will enter the system. Driplines shall not be placed with kinks or sharp bends; that section of dripline shall be replaced at the direction of the Contracting Officer.

6.4.1 Plastic Pipe shall be installed in accordance with the procedures recommended in ASTM D 2774 and as herein specified.

6.4.2 Tracer wire or tracer tape shall follow the main lines and terminate in the valve box with the gate valve that controls these main irrigation lines. Provide enough length of wire or tape to make a loop and attach a plastic label with the designation "Tracer Wire."

6.5 Jointing.

6.5.1 Galvanized Steel 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.

6.5.2 Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer. PVC to metal connections shall utilize teflon tape.

6.6 Pipe and Conduit Sleeves shall be installed with a minimum of off-set at the joints to permit easy installation and removal of the irrigation and conduit lines. All plastic lines shall be installed in sleeves 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:

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

Number of Wires	Minimum Conduit Size inches
1 to 10	1
1 to 27	2

6.7 Setting of Valves, and Boxes. Valves and valve boxes shall be installed where shown or 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. Earthfill

SECTION 2K

CONCRETE SIDEWALKS, CURBS, GUTTERS AND DRIVEWAY ENTRANCES

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 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO M 182	(1960; R 1974) Burlap Cloth Made From Jute or Kenaf

1.2 American Society for Testing and Materials (ASTM).

ASTM C 94	(1989b) Ready-Mixed Concrete
ASTM C 171	(1969; R 1986) Sheet Materials for Curing Concrete
ASTM C 309	(1989) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 1751	(1983) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1850	(1974; R 1979) Concrete Joint Sealer, Cold-Application Type

1.3 Federal Specification (FS).

FS SS-S-1401	(Rev C; Notice 1) Sealant, Joint, Non-Jet-Fuel-Resistant, Hot Applied, for Portland Cement and Asphalt Concrete Pavements

2. FIELD-CONTROL TESTS. Preparation of field-control samples and testing of samples shall be by the Contractor at no additional cost to the Government. The taking of samples, the making of test specimens, and the testing thereof shall be performed under the supervision of the Contracting Officer.

3. MATERIALS. Materials shall conform to the respective publications and other requirements specified herein.

3.1 Concrete Curing Materials.

3.1.1 Burlap. AASHTO M 182 having a weight of 14 ounces or more per square yard when dry, and shall be non-staining.

3.1.2 Impervious Sheeting. ASTM C 171.

3.1.3 Liquid Membrane Curing Compound. ASTM C 309 Type 1D. Compound shall be free of paraffin or petroleum.

3.2 Concrete Protection Materials. Linseed oil mixture shall be equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used except that emulsified mixtures are not acceptable.

3.3 Joint Materials.

3.3.1 Expansion Joint Fillers. ASTM D 1751 or ASTM D 1752 or shall be resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

3.3.2 Joint Sealers. ASTM D 1850 or FS SS-S-1401.

4. CONCRETE STRENGTH AND USAGE.

4.1 Concrete. Concrete and materials therefore shall conform to the applicable requirements of SECTION: CONCRETE and ASTM C 94, Alternative No. 2 except as specified below. Concrete shall have a minimum compressive strength of 2,500 psi. The maximum size of aggregate shall be one inch. Concrete shall have a slump of not more than 3 inches.

4.2 Color. An integral color admixture shall be added to the curb and gutter concrete adjacent to the maintenance road, and exposed footings for gates and bollards. The colors shall conform to the requirements of the SECTION: CONCRETE.

5. FORMS.

5.1 Sidewalk. Sidewalk forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete, and of a height equal to the full depth of the finished sidewalk. 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, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. 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. Form ends shall be interlocked and self-aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. 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.

5.2 Curb, Gutter, and Driveway Entrance. Curb and gutter forms shall be of wood or steel, straight, and of sufficient strength to resist springing during depositing and consolidating the concrete. The outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Straight forms of wood 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, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. 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. Form ends shall be interlocked and self-aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. 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. Rigid forms shall be provided for curb returns, except that benders of thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

6. SUBGRADE PREPARATION. The subgrade shall be constructed to grade and cross section.

6.1 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.

6.2 Curb, Gutter, and Driveway Entrance 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 SECTION: FILLS AND SUBGRADE PREPARATION. The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter.

6.3 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.

7. FORM SETTING.

7.1 Sidewalk. Forms for sidewalks 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 roadway. 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, except that with probable freezing temperatures, oiling is mandatory. Side forms shall not be removed for less than 12 hours after finishing has been completed.

7.2 Curbs and Driveway Entrances. Forms for curbs and driveway entrances shall be set to alignment and grade and to conform to the dimensions of the curb and driveway entrances. Forms shall be held rigidly in place by the use of stakes placed at intervals not to exceed 4 feet. Clamps, spreaders, and braces shall be used where required to insure rigidity in the forms. The forms on the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

8. CONCRETE PLACEMENT AND FINISHING.

8.1 Sidewalk Concrete. Concrete shall be placed in the forms in one layer of such thickness that when compacted and finished the sidewalk 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 corrected. The surface shall be divided into rectangular areas by means of contraction joints spaced at not more than 5 feet on centers.

8.1.1 Concrete Finishing. After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic. Contractor shall submit installation procedures for concrete to the Contracting Officer for approval. All sidewalk and bike path surfaces shall be given a rough texture by brooming with a fiber-bristle broom in a direction transverse to that of the main traffic flow. The rough texture finish shall also be applied to adjacent surfaces a sufficient distance in all directions to provide adequate texture for traction in turning areas.

8.1.2 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.

8.1.3 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 sidewalk 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.

8.1.4 Expansion Joints. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. 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 sidewalk 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 cleaned and filled with joint sealer. Concrete at the joint shall be surface dry, and the atmospheric and pavement temperatures 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 walk surface. Spilled sealing material shall be removed immediately and the surface of the walk cleaned. Dummy groove joints shall not be sealed.

8.1.5 Surface Uniformity. The completed surface shall be uniform in color and free of surface blemishes and tool marks.

8.2 Curb, Gutter, and Driveway Entrance Concrete. Concrete shall be placed in layers not to exceed 6 inches. Concrete shall be thoroughly consolidated by tamping and spading or with approved mechanical vibrators.

8.2.1 Concrete Finishing. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2-inch and the surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float. Except at grade changes or curves, finished surfaces shall not vary, from the testing edge of 10-foot straightedge, more than 1/8 inch for gutter and entrance and 1/4 inch for top and face of curb. Irregularities exceeding the above shall be satisfactorily corrected. Visible surfaces and edges of finished curb and gutter shall be free of blemishes and form and tool marks, and shall be uniform in color, shape, and appearance.

8.2.2 Joints. Expansion joints and contraction joints shall be constructed at right angles to the line of curb and gutter.

8.2.2.1 Contraction Joints. Contraction joints shall be constructed by means of 1/8-inch thick separators, of a section conforming to the cross section of the curb and gutter. Contraction joints shall be constructed directly opposite contraction joints in abutting portland-cement-concrete pavement. Where curb and gutter do not abut portland-cement-concrete pavements, contraction joints shall be so placed that monolithic sections between curb returns will not be less than 5 feet nor greater than

15 feet in length. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint. Separators shall be removed prior to finishing.

8.2.2.2 Expansion Joints. Expansion joints shall be formed by means of preformed expansion-joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb at the end of all returns. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland-cement-concrete pavement and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland-cement-concrete pavement, expansion joints at least 1/2-inch in width shall be provided at intervals not exceeding 25 feet. Expansion joints shall be provided in non-reinforced concrete gutter at locations indicated.

9. CURING AND PROTECTION.

9.1 Curing. Immediately after the finishing operations, exposed concrete surfaces shall be cured by one of the following methods as the Contractor may elect.

9.1.1 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.

9.1.2 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.

9.1.3 Membrane-Curing Method. The entire exposed surface shall be covered with a membrane-forming curing compound. Where type 1 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. Color concrete shall be cured as specified in SECTION: CONCRETE.

9.2 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.

9.3 Protection. Completed concrete shall be protected from damage until accepted. The Contractor shall 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.

10. SEALING JOINTS. The approximately horizontal sections of expansion joints and the top one-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.

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SECTION 2L

STONE PROTECTION

Index

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 C 88	(1983) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 295	(1985) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 1141	(1986) Substitute Ocean Water

2. MATERIALS.

2.1 Definitions.

a. Cobblestone. Stone which is obtained from alluvial deposits and is nearly spherical and well rounded (river-run), ranging from 4 to 12 inches in size.

b. Stone. Sound, durable, weather-resistant rock over 4 inches in diameter resulting 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 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 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 desires to utilize more than one source, additional testing will be accomplished by the Government for the sum of $1700 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 Corps of Engineers, 25 Libertyship Way, Sausalito, California 94965. 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 stone does not comply with the specifications.

2.2.1 Potential Stone Sources. Stone may be furnished from any source designated by the Contractor and approved by the Contracting Officer subject to the conditions stated herein.

2.2.2 It is anticipated that stone conforming to these specifications will not be available from the required excavation. The required stone will need to be obtained from offsite source. If sufficient amounts of stone conforming to these specifications are not available from a source used in the work, the Contractor shall submit stone from another source for approval.

2.3 Quality Compliance. Test results and/or service records will be used by the Contracting Officer 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 of stone will be considered for sampling and testing the Contractor must demonstrate that the source has sufficient stone to fulfill the contract requirements.

2.3.1 Service records are considered to be acceptable if stone from a proposed source has remained sound and functional after 10 or more years of exposure on a project similar to the one to be constructed under these specifications.

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)
Sulfate Soundness	ASTM C 88(2)	10% max. loss
Abrasion Loss	ASTM C 535	50% max. 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 expansive clay.

NOTE: (1): Test procedure for wetting-and-drying test. 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, one inch thick (± 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 action 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,+/-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 lamination, 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. Each gradation 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. 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 for each 5,000 tons of material placed. 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 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: FILLS AND SUBGRADE PREPARATION, and shall be inspected, in sufficient time prior to each stone placement by the Contractor in order 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.

4. SCALE WEIGHT MEASUREMENT. Scales used for measurement shall, at the option of the Contractor, be either public scales or approved scales provided by the Contractor. Weighing shall be at the point nearest the work at which a public scale is available or at which it is practicable for the Contractor to provide a scale. Scales shall be standard truck scales of the beam type and shall be equipped with the type registering beam and an "over and under" indicator and be capable of accommodating the entire vehicle. Scales shall be tested, approved and sealed by an inspector of the state in which the scale is located. Scales shall be calibrated and resealed as often as necessary and at least once every 3 months, to insure continuous accuracy. All calibrations and sealing of the scales shall be at the expense of the Contractor. The necessary number of standard weights for testing the scales shall be on hand at all times. When the Contractor's scales are used, the Contractor shall be certified and bonded as a licensed weighmaster in accordance with all requirements of the State Inspection Bureau, and any employees of the Contractor engaged in weighing materials under this contract shall be deputized to perform such weighing under the provision of the State Inspection Bureau charged with scales inspection. No more than one licensed weighmaster shall be employed during a single shift of weighing under the provision of the State Inspection Bureau charged with scales inspection. No more than one licensed weighmaster shall be employed during a single shift of weighing operations. Multiple weighmaster including individual truck drivers are prohibited. Vehicles used for hauling materials shall be weighed empty daily at such time as desired, and each shall bear a plainly legible identification mark.

5. WEIGH BILLS AND DELIVERY TICKETS. Copies of weigh bills or delivery tickets shall be submitted to the Contracting Officer during the progress of the work. The Contractor shall furnish the Contracting Officer or his designated representative scale tickets for each load of material weighed; these tickets shall include tare weight, identification mark of each vehicle weighed, date, time, and location of loading. Tickets shall be furnished at the point and time individual loads arrive at the work site. A master log of all vehicles loading shall be furnished for each day of loading operation. The Contractor shall file with the Contracting Officer or his designated representative, the master log of loadings, certified weigh bills and/or certified tickets within 24 hours of material delivery. Prior to final payment, the Contractor shall furnish written certification that the material recorded on the submitted weigh bills and/or certified tickets are actually used in the construction covered by the contract.

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SECTION 2M

SIDE DRAINS, GAGING STATION, MANHOLES
AND MANHOLE ADJUSTMENTS

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 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO M 33	(1981) Preformed Expansion Joint Filler for Concrete (Bituminous Type)
AASHTO M 91	(1978; R 1986) Sewer and Manhole Brick (Made from Clay or Shale)
AASHTO M 114	(1985) Building Brick (Solid Masonry Units made from Clay or Shale)
AASHTO M 170	(1987I) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
AASHTO M 198	(1975; R 1986) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 199	(1987I) Precast Reinforced Concrete Manhole Sections

1.2 American National Standards Institute (ANSI).

ANSI A14.3	(1984) Safety Requirements for Fixed Ladders

1.3 American Society for Testing and Materials (ASTM).

ASTM C 32	(1973; R 1984) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 55	(1985) Concrete Building Brick

ASTM C 62	(1988) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 76	(1988) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 270	(1989) Mortar for Unit Masonry
ASTM C 443	(1985a) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1988a) Precast Reinforced Concrete Manhole Sections
ASTM D 1556	(1982) Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1978) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.45kg) Rammer and 18-in. (457 mm) Drop
ASTM D 1751	(1983) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984) Preformed Sponge Rubber and Cork Expansion Joint Filler for Concrete Paving and Structural Construction
ASTM D 2216	(1980) Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D 3034	(1988) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1986) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

1.4 American Water Works Association (AWWA).

AWWA C111	(1988) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C150	(1981; Errata; R 1986) Thickness Design of Ductile-Iron Pipe

1.5 Federal Specification (FS).

FS HH-P-117	Packing, Jute, Twisted

FS SS-S-210	(Rev A; Am 1) Sealing Compound, Preformed Plastic for Expansion Joints and Pipe Joints

1.6 Federal Standard (FED STD).

FED STD 601	(Basic; Notice 7) Rubber, Sampling and Testing

1.7 Maricopa Associations of Governments, (MAG).

MAG-01	(1979) Uniform Standard Specifications for Public Works Construction (and the City of Phoenix supplement)

2. SUBMITTALS.

2.1 Manufacturers Recommendation. 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 submitted to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to submit the recommendations can be cause for rejection of the material.

3. CERTIFICATION. Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

4. DELIVERY, STORAGE, AND HANDLING OF MATERIALS.

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

4.2 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.

5. PIPE FOR SIDE DRAINS.

5.1 Reinforced concrete pipe shall conform to requirements for the following pertinent types. ASTM C 76 or AASHTO M 170, Class as indicated on the drawings.

5.2 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.

5.3 Ductile Iron Pipe. All water line pipe shall comply with subsection 750.2, entitled "Ductile Iron Water Pipe," of MAG-01 and shall be minimum Class 51, in accordance with AWWA C150. All pipe, unless otherwise indicated on the drawings, shall comply with AWWA C111 for mechanical joint pipe, C1.150. Fittings shall be mechanical joints with cement mortar lining and coal-tar coated.

6. INLET STRUCTURE. Construction shall be cast-in-place reinforced concrete complete with frames and covers.

7. MATERIALS FOR DRAINAGE STRUCTURES.

7.1 Brick. Brick shall conform to ASTM C 62 or AASHTO M 114, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32 or AASHTO M 91, Grade MS. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

7.2 Concrete. Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under SECTION: CONCRETE. Expansion-joint filler material shall conform to ASTM D 1751, ASTM D 1752, or AASHTO M 33, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752. Color admixture shall be excluded for this item.

7.3 Flap Gates, Grating and Frames. Flap gates, gratings, and frames shall conform to the requirements of SECTION: MISCELLANEOUS METALS.

7.4 Ladders. Ladders shall be steel, individual rung, ladders in accordance with ANSI A14.3 or MAG-01. Rungs shall be galvanized, solid-section, rods imbedded into concrete as indicated on the drawings.

7.5 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 one hour. Color admixture shall be excluded for this item.

7.5.1 The quantity of water in the mixture shall be only that sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

7.5.2 The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

8. JOINTS.

8.1 For Concrete Pipe Use Cement-Mortar Bell-and-Spigot Joint. The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be cleaned with wet brush and the lower portion of the bell filled with mortar to such depth as to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into the bell so that sections are closely fitted. After each section is laid, remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. Cement mortar, finish, and protection of joints shall be as specified in paragraph: MATERIALS FOR DRAINAGE STRUCTURES. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

8.1.1 Cement-Mortar Oakum Joint for Bell-and Spigot Pipe. A closely twisted gasket shall be made of jute or oakum, in accordance with FS HH-P-117, of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket then shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space then shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type joint shall be kept at least five joints behind laying operations. The cement mortar, finish, and protection of joints shall be as specified in paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.2 Cement-Mortar Diaper Joint for Bell-Spigot Pipe. The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and outside of spigot shall be cleaned.

8.1.2.1 Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut into such lengths that they will extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for ends to be twisted at top of pipe to hold band securely in place; bands shall be accurately centered around lower portion of joint.

8.1.2.2 Grout shall be poured between band and pipe from only the high side of band, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to insure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be carefully forced out by pouring and removed.

8.1.2.3 The remaining unfilled upper portion of the joint shall then be filled with mortar and a bead formed around outside of this upper portion of the joint with sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until the joints have been fully inspected by the Contractor and approved by the Contracting Officer. The Contractor shall notify the Contracting Officer 24 hours prior to inspecting the joints. The cement mortar, finish and protection of the joints shall be as specified in paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.2.4 The inside of the joint and the annular space shall be cleaned by brooming or other approved methods. The inside of the joint and the annular space shall then be dry packed so as to supply an unbroken flow line between adjacent pipe segments.

8.1.3 Cement-Mortar Tongue-and Curve Joint. The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The groove end of the first pipe shall be cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe then shall be inserted in the groove end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside. The cement mortar, finish, and protection of joints shall be as specified in the paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.4 Cement-Mortar Diaper Joint for Tongue-and Groove Pipe. The joint shall be of the type described for Cement-Mortar Tongue-and-Groove Joint, in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2-inch thick, and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. No backfilling around the joints shall be done until the joints have been fully inspected and approved. The cement mortar, finish, and protection of joints shall be as specified in the paragraph: MATERIALS FOR DRAINAGE STRUCTURES.

8.1.5 Self-Centering Tongue and Groove Pipe. "Self-centering" tongue and groove pipe 36 inches or greater in diameter will not require outside grouting except where the pipe is used on curves or angle points. All joints shall be butted together. The overlap of the tongue and the groove portion of the joint shall not be less than 50 percent of the overlap measured from the manufacturer's designed full seat position. The material and layout drawings shall specify the maximum inside annular space that satisfies these specifications. Non-conforming joints shall require outside grouting or a concrete collar as determined by the Contracting Officer.

8.1.5.1 The inside annular space between pipe sections shall be completely filled with mortar and finished smooth with the inside pipe surface. All joints shall be cleaned with a wire brush and wetted before mortaring. Joints shall not be mortared before the next two joints in advance are laid. The entire depth of the finished inside joint shall be filled with mortar in such a manner as to insure a strong tight joint.

8.1.5.2 Tongue and groove joints will not be permitted for pipe under 36 inches in diameter.

8.1.6 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 FS 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 jointing 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.

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

9. EXCAVATION AND TRENCHING AND BACKFILLING FOR SIDE DRAINS. Excavation and backfilling of trenches for side drains, storm drains, and appurtenances, shall be in accordance with paragraph: General Requirements for Compacted Fills and Compacted Backfills of SECTION: FILLS AND SUBGRADE PREPARATION and the following requirements.

9.1 Trenching. All excavations shall be made by open cut unless otherwise specified. The banks of trenches shall be kept as nearly vertical as practicable. Unless otherwise indicated, the banks of trenches below the level of the top of the pipe shall be not less than 12 inches wider nor more than 16 inches wider than the outside diameter of the pipe to be laid therein, and shall be excavated true to line, so that a clear space not less than 6 inches nor more than 8 inches in width is provided on each side of the pipe. The maximum width of trench specified applies to the width at any point below the top of the pipe; the width of the trench above the top of the pipe may be made as wide as necessary for sheathing and bracing; and the proper installation of the work. Care shall be taken not to overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for the proper sealing of pipe joints.

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 unexpectedly encountered in bottom of trench, such material shall be removed to depth required and replaced to the proper grade with selected material, and 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. Removal of unstable material shall be done at no additional cost to the Government.

9.3 Excavation for Drainage Structures. Excavation for junction structures, drop inlets, catch basins or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as indicated on the drawings. Removal of unstable material shall be as specified hereinbefore. 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 shall not be made until just before the concrete or masonry is to be placed.

10. MATERIALS FOR BEDDING AND BACKFILLING.

10.1 General. Bedding for side drains shall consist of sandfill placed around the pipe in accordance with paragraph: BACKFILLING. Compacted fill above the sandfill shall be placed in accordance with the paragraph: BACKFILLING. Material for the sandfill for the side drain shall be clean sand, free of trash, organic materials, debris and with 100 percent passing No. 4 sieve and not more than 10 percent passing the No. 100 sieve.

10.2 Material for compacted fill above the sandfill shall not contain any stone larger than one inch and may consist of sand, gravelly sands, silty sands and clayey sands. Organic material, trash debris, silt, sandy silt, clay, sandy clay, broken concrete or pavement and other objectionable material shall not be used.

11. BEDDING. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. Pipe shall be bedded carefully in a sandfill layer accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe for the entire length of pipe. The layer of sandfill material shall be at least 4 inches. 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.

12. PLACING PIPE. Each pipe shall be 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. 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. Laying shall proceed upgrade with spigot ends of bell-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of flow.

13. BACKFILLING.

13.1 Backfilling, Pipe and Utilities in Trenches. After the bedding has been prepared and the pipe installed, sandfill 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. Vibrating compaction equipment shall be used to obtain not less than 90 percent of maximum density. Care shall be taken to insure thorough compaction of the sandfill under the haunches of the pipe. Above the springing line, the trench shall be filled with material conforming to paragraph: MATERIALS FOR BEDDING AND BACKFILLING. The completed fill material shall be placed along both sides of pipe in layers not exceeding 4 inches in compacted depth of pipe at a moisture content that will facilitate compaction. 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 90 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 or to the bottom of the aggregate base course. The remainder of the trench shall be backfilled and compacted by spreading and rolling parallel with the pipe in layers not exceeding 6 inches or 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.

13.2 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 the 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 90 percent of maximum density. Prior to commencing normal filling operation, 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 in layers not exceeding 6 inches.

13.3 Movement of Construction Machinery. When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a side drain at any stage of construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at no additional cost to the Government.

13.4 Backfilling for Drainage Structures. After the junction structure, drop inlet, catch basin or similar structure has been constructed, backfill around and above structure shall be placed in accordance to the requirements of paragraph: BACKFILLS of SECTION: FILLS AND SUBGRADE PREPARATION and as specified herein.

13.4.1 The structure shall not be damaged by the shock of falling earth and the backfill shall be placed in such a manner as to prevent eccentric loading and excessive stress on the structures. Any damaged structure thereby shall be repaired or replaced at no cost to the Government.

13.5 Compaction.

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

13.5.2 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 and field moisture content shall be determined in accordance with ASTM D 2216.

14. MANHOLE ADJUSTMENTS. Adjustments shall be as shown on drawings.

15. INSPECTION MANHOLES. Construction shall be precast reinforced concrete in accordance with AASHTO M 199 or ASTM C 478 complete with frames and covers as shown on the drawings. Frames and covers shall conform to the requirements of SECTION: MISCELLANEOUS METALS.

16. GAGING STATION. Station shall be as shown on the drawings.

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SECTION 2N

GROUTING STONE PROTECTION

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 American Society for Testing and Materials (ASTM).

ASTM C 150	(1989) Portland Cement
ASTM C 309	(1989) Liquid Membrane-Forming Compounds for Curing Concrete

2. MATERIALS.

2.1 Aggregate shall conform to the requirements specified for fine aggregate of the SECTION: CONCRETE.

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 requirement of ASTM C 309 Type 1D. The compound shall be free of paraffin or petroleum.

3. MIXING. Grout shall be composed of cement, sand, and water mixed in the 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 panels 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 test panel shall conform to Munsell color number 10YR 5/3 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 requirement per cubic yard of grout 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 shall 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 workers 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 of 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.

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 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 materials.

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SECTION 2P

SUBDRAINAGE SYSTEM

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 American Society for Testing and Materials (ASTM).

ASTM D 123	(1988) Terminology Relating to Textiles
ASTM D 1682	(1964; R 1975) Breaking Load and Elongation of Textile Fabrics
ASTM D 1683	(1981) Failure in Sewn Seams of Woven Fabrics
ASTM D 3034	(1988) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3787	(1980a) Bursting Strength of Knitted Goods Constant-Rate-of-Traverse (CRT) Ball Burst Test
ASTM D 4491	(1985) Water Permeability of Geotextiles by Permittivity

1.2 U.S. Army Corps of Engineers, Engineering Manuals (COE).

COE EM 1110-2-1906	Laboratory Soils Testing

2. SUBMITTALS.

2.1 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 submitted to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to submit the recommendations can be cause for rejection of the material.

2.2 Certification. Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

3. DELIVERY, STORAGE, AND HANDLING OF MATERIALS.

3.1 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.

3.2 Handling. Materials shall be handled in such a manner as to insure delivery to the site in sound undamaged condition. Pipe shall be carried to the trench, not dragged. Plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

4. DRAIN AGGREGATE. A filter course layer of drain aggregate shall be placed on the prepared subgrade as shown on the plans. The thickness of the drain aggregate shall be as shown on the drawings and it shall be placed in such a manner as to avoid segregation of sizes. Where applicable, compaction of the material shall be accomplished by 2 passes of a heavy rubber-tired roller or other approved compaction equipment. Drain aggregate, consisting of gravel and sand shall be of clean, hard, tough, durable quality and free from laminated, soft or flaky particles, shale, organic matter or other deleterious material. Material shall be graded between the limits specified below:

DRAIN AGGREGATE

Sieve Size U.S. Standard Square Mesh	Percent Passing by Weight
1 inch	100
3/4 inch	90-100
3/8 inch	15-45
No. 4	0-5

5. PVC PIPE AND FITTINGS. ASTM D 3034, Type PSM with a maximum SDR of 35, size 3-inch in diameter, with flexible elastomeric seal joint.

6. FILTER FABRIC.

6.1 Geotextile. The geotextile shall be a non-woven pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall meet the physical requirements listed in Table No. 1 of the specifications. The geotextile fiber shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amide, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration due to ultra-violet and heat exposure. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

6.2 Seams. The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary, to form sections not less than 10 feet wide. Seams shall be tested in accordance with method ASTM D 1683, using 1-inch square jaws and 12 inches per minute constant rate of traverse. The strengths shall be not less than 90 percent of the required tensile strength (Table 1) of the unaged geotextile in any principal direction.

6.3 Acceptance Requirements. All brands of geotextile and all seams to be used shall be accepted on the following basis. The Contractor shall furnish the Contracting Officer, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification. If requested by the Contracting Officer, the Contractor shall provide to the Government geotextile samples for testing to determine compliance with any or all of the requirements in this specification. When samples are to be provided, they shall be submitted a minimum of 60 days prior to the beginning of installation of the same geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation.

6.4 Determination of Equivalent Opening Size (EOS). Five unaged geotextile samples shall be tested. Obtain 50 gm of each of the following fractions of standard glass beads:

U.S. Standard Designated Sieve Number			U.S. Standard Designated Sieve Number		
EOS	Passing	Retained On	EOS	Passing	Retained On
20	18	20	60	50	60
30	25	30	70	60	70
40	35	40	80	70	80
50	45	50	100	80	100
120	100	120	140	120	140

TABLE NO. 1 - PHYSICAL REQUIREMENTS

Physical Property	Test Procedure	Acceptable Values ++ Note 2
Tensile Strength (unaged geotextile) Note 1	ASTM D 1682 Grab Test Method using 1 inch square jaws and a 12 inches per minute constant rate of traverse.	120 pound minimum in any principal direction
Breaking Elongation (unaged geotextile)	ASTM D 1682 Determine Apparent Breaking Elongation	15 percent minimum in any principal direction
Puncture Strength (unaged geotextile) Note 1	ASTM D 3787 except polished steel ball replaced with a 5/16-inch diameter solid steel cylinder with a hemispherical tip centered within the ring clamp.	40 pound minimum
Equivalent Opening Size (EOS)	Specification Paragraph entitled "Determination of Equivalent Opening Size (EOS)."	No finer than the U.S. Standard Sieve No. 70 and no coarser than the U.S. Standard Sieve 30.

Geotextile Permeability (k sub G)	ASTM D 4491 Test Methods for Water Permeability of Geotextiles By Permittivity	The permeability of the Geotextile shall be at least 0.001 cm/sec but not greater than 0.20 cm/sec

Note 1. Unaged geotextile is defined as geotextile in the condition received from the manufacturer or distributor.

Note 2. All numerical values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the minimum in the table). Two possible sources of suitable glass beads are:

Cataphote Division
Ferro Corporation
P.O. Box 2369
Jackson, Mississippi 39205
Telephone: (601) 939-4631

or

Potters Industries Inc.
377-T Route 17
Hasbrouck Heights, NJ 07604
Telephone: (201) 288-4700

Glass beads should be at least 90 percent true spheres. Beads should not be used without verifying the sizing by sieving on the sieves given above for each designated EOS. Beads shall be periodically re-sieved to eliminate beads of other sizes, broken beads, and other undesirable material. The geotextile shall be affixed to a standard sieve 8 inches in diameter having openings larger than the largest beads to be used in the test. The textile shall be attached to the sieve in such a manner that no beads can pass between the geotextile and the sieve wall. Shaking shall be accomplished as described in paragraph 2d(1) (g), Appendix V, COE EM 1110-2-1906, except the time for shaking shall be 20 minutes. Determine by sieving (using successively coarser fractions) that size of beads of which five percent or less by weight passes through the geotextile; the equivalent opening size, EOS of the geotextile specimen is the "retained on" U. S. Standard Sieve number or nominal sieve opening in millimeters of this fraction. A minimum of five randomly chosen specimens shall be tested. The EOS for the fabric sample shall be reported as the values representing the largest and smallest EOS values of the individual specimens.

6.5 Determination of Percent of Open Area. Five samples of unaged woven geotextile shall be placed separately in a 2-inch by 2-inch slide holder and the image projected with a slide projector on a rigid screen. A square block of 25 openings near the center of that image shall be selected and the length and width of each of the 25 openings shall be measured to the nearest 0.02 inch. The total area shall be determined by measuring the length of the sides of the 5 openings and 5 adjacent fibers in each direction to the nearest 0.02 inch. The percent open area is determined by dividing the sum of the 25 open areas by the total area of the 25 openings and their adjacent fibers. The percent open area shall be quoted as the percent determined by averaging the percent open areas of the five individual specimens. However, if more than one of the five specimens are outside the specified POA limits, the fabric shall be considered to have failed the test.

6.6 Installation of the Geotextile. The geotextile shall be placed in the manner and at the locations shown on the drawings. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris and soft or low density pockets of material. Erosion features such as rills, gullies, etc. must be graded out of the surface before geotextile placement. The geotextile shall be placed with the long dimension parallel

to the centerline of the channel and laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 12 inches of overlap for each joint. Temporary pinning of the textile to help hold it in place until the drainage aggregate is placed shall be allowed. The temporary pins shall be removed as the drainage aggregate is placed to relieve high tensile stress which may occur during placement of material on the geotextile. The placement procedure requires that the length of the geotextile be approximately 15 percent greater than the slope length. The Contractor shall adjust the actual length of the geotextile used based on initial installation experience. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of drainage aggregate shall be replaced by the Contractor at no cost to the Government. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of riprap or other materials. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary. Before placement of drainage aggregate, the Contractor shall demonstrate that the placement technique will prevent damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

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SECTION 2Q

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 (FS).

FS TT-P-115	(Rev F) Paint, Traffic, (Highway, White and Yellow)

1.2 Federal Standard (FED STD).

FED STD 141	(Rev C) Paint, Burnished, Lacquer and Related Materials, Methods of Inspection, Sampling, and Testing

2. MATERIALS. Paint shall be in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacturer, 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 Paints. Paints shall conform to FS TT-P-115. Color shall be white.

3. SAMPLING AND TESTING. Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply. Upon notification by the Contractor that the material is at the site or source of supply, a quart sample of each batch of paint shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Contents of the sampled containers shall be so thoroughly mixed as to render the sample truly representative. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. The material may be approved for use based on either the following data furnished by the Contractor:

a. A test report showing that the proposed batch meets all specified requirements.

b. A test report showing that a previous batch manufactured using the same formulation as that used in the proposed batch met all specified requirements, and a report showing test results on the proposed batch for the following properties required in the material specification: weight per gallon, viscosity, fineness of grind, drying time, and gradation. Testing procedures and reports shall be as specified in paragraph 5 of Method 1031.2 of FED STD 141. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application. When tested by the Government and samples fail to meet specification requirements, the materials represented by the samples shall be replaced and cost of testing will be deducted from the payments due the Contractor at the rate of $100 per sample retested.

4. 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.

4.1 Sandblasting Equipment. Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 c.f.m. of air at a pressure of not less than 90 psi at the nozzle for each nozzle used.

5. 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. Where oil or grease are present on old pavements to be marked, affected areas shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping and marking. Surfaces shall be recleaned, when work has been stopped due to rain.

6. 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.

6.1 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. All 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.

6.2 Traffic Controls. Suitable warning signs shall be placed near the beginning and end of the worksite for alerting approaching traffic. Small markers shall be placed along newly painted lines to control traffic and prevent damage to newly painted surfaces.

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SECTION 2R

SCOUR GAGES

1. MATERIALS.

1.1 Concrete. Scour gages shall be constructed to the dimensions and at the locations indicated on the drawings, of integrally colored precast concrete. Concrete shall conform to the requirements of SECTION: CONCRETE, except that the maximum aggregate size shall be 3/8 inch. The final surface of the concrete shall be finished smooth and without blemish.

1.2 Color additive shall be manufacturers' standard black pigmented color additive. Additive shall be mixed in accordance with manufacturers' written instructions and in sufficient quantities to provide vivid coloration of the concrete. The color shall be certified as non-fading by the supplier.

2. TOLERANCE. Tolerance of scour gages shall be within 1/32 inch of the dimension indicated on the drawings.

3. INSTALLATION. Scour gages shall be installed perpendicular and flush to finish surfaces where indicated.

* * * * *

$$60\ \text{mm} \times \frac{1\ \text{m}}{1000\ \text{mm}} \times \frac{39.27\ \text{in}}{1\ \text{m}} = 2.36''$$

SECTION 2S

CONCRETE PAVING STONE

1. APPLICABLE PUBLICATIONS. The American Society for Testing and Materials (ASTM) 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.

ASTM C 33	(1986) Concrete Aggregates
ASTM C 936	(1982; R 1988) 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.

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 stones (pavers) shall conform to ASTM C 936, 60mm in thickness, made from normal weight aggregates and Portland cement, and shall be of the shape, size, and color indicated on the drawings.

5.2 Admixtures. Admixtures, if used, shall conform to the requirements of the SECTION: CONCRETE.

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 1-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 paved 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.

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SECTION 2U

WATER LINES

Index

PART 1 GENERAL

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

1.1 American National Standards Institute, Inc. (ANSI).

ANSI B16.1	(1975) Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B36.10M	(1985) Welded and Seamless Wrought Steel Pipe

1.2 American Society for Testing and Materials (ASTM).

ASTM A 53	(1988a) Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
ASTM B 88	(1988a) Seamless Copper Water Tube
ASTM D 1599	(1988) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings
ASTM D 1784	(1981) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1988) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1988) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1988) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2467	(1988) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1988) Solvent Cements for Poly(Vinyl

	Chloride) (PVC) Plastic Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1983) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1988) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting Resin) Pipe
ASTM D 2997	(1984) Centrifugally Cast Reinforced Thermosetting Resin Pipe
ASTM D 3517	(1986) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
ASTM D 3839	(1979) Underground Installation of Flexible Reinforced Thermosetting Resin Pipe and Reinforced Plastic Mortar Pipe
ASTM F 477	(1976; R 1985) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.3 American Water Works Association (AWWA).

AWWA B300	(1987) Hypochlorites
AWWA B301	(1987) Liquid Chlorine
AWWA C104	(1985) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1982) Polyethylene Encasement for Ductile-Iron Piping for Water and other Liquids
AWWA C110	(1987) Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids
AWWA C111	(1985) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	(1983) Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	(1986) Ductile-Iron Pipe, Centrifugally Cast and in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

AWWA C153	(1988) Ductile-Iron Compact Fittings, 3 In. through 6 In. for Water and Other Liquids)
AWWA C200	(1986) Steel Water Pipe 6 In. and Larger
AWWA C203	(1986) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape-Hot-Applied
AWWA C205	(1985) Cement-Mortar Protective Lining and Coating for Steel Water pipe--4 In. and Larger--Shop Applied
AWWA C207	(1986) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In.
AWWA C208	(1983) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C500	(1986) Gate Valves for Water and Sewage Systems
AWWA C504	(1980) Rubber-Seated Butterfly Valves
AWWA C509	(1987) Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems
AWWA C600	(1987) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1986) Disinfecting Water Mains
AWWA C700	(1977) Cold Water Meters--Displacement Type
AWWA C701	(1978) Cold Water Meters--Turbine Type for Customer Service
AWWA C800	(1984) Underground Service Line Valves and Fittings
AWWA C900	(1981; Errata) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water
AWWA M16	(1978) Work Practices for Asbestos-Cement Pipe
AWWA M23	(1980) PVC Pipe - Design and Installation

1.4 Ductile Iron Pipe Research Association (DIPRA).

DIPRA-01	(1986, 2nd Ed.) Thrust Restraint Design for Ductile Iron Pipe

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

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

1.6 Military Specifications (MS).

MS MIL-P-28584	(Rev. B) Pipe and Pipe Fittings, Glass Fiber Reinforced Plastic, for Condensate Return Lines

1.7 National Fire Protection Association (NFPA).

NFPA 49	(1975) Hazardous Chemicals Data
NFPA 325M	(1984) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1985) Identification of the Fire Hazards of Materials

1.7 National Sanitation Foundation (NSF).

NSF Std 14	(Oct. 1965, Rev. thru Oct. 1987) Plastic Piping System Components and Related Materials

2. GENERAL. This section covers water 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 Lines. Piping for water lines less than 3 inches in diameter shall be Polyvinyl Chloride (PVC) plastic, unless otherwise shown or specified. Piping for water lines for sizes 3 inches and larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic through 12-inch nominal diameter, filament-wound reinforced or centrifugally cast reinforced, thermosetting resin, thermosetting reinforced plastic mortar pressure pipe, or steel, unless otherwise shown or specified.

2.2 Plastic Pipe. All thermoplastic piping system components (PVC) intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

2.3 Excavation, Trenching, and Backfilling for Water Lines. Excavation, ;trenching, and backfilling shall be in accordance with the applicable provisions of SECTION: SIDE DRAINS, GAGING STATIONS, MANHOLES, AND MANHOLE ADJUSTMENTS, except as modified herein.

3. SUBMITTALS. The following shall be submitted in accordance with SECTION: SPECIAL CLAUSES:

3.1 Design Analysis and Calculations. All calculations shall be submitted to the Contracting Officer for approval.

3.2 Manufacturer's Instructions. The Contractor shall, as a part of the detail 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.

3.3 Safety Plan. The method proposed for disposal of waste water from hydrostatic tests and disinfection shall be submitted to the Contracting Officer for approval prior to performing hydrostatic tests.

3.4 Training Data. The manufacturer shall assist the Contractor by training and instructing the Contractor's personnel in proper installation procedures and techniques. Certification will be required in writing from the manufacturer listing the names of those persons so qualified. The manufacturer's representative shall be a person regularly engaged in such service and shall be certified in writing by the manufacturer to be technically qualified and experienced to supervise this training.

3.5 Certificates of Compliance. Upon completion of the project and before final acceptance, the Contractor shall deliver to the Contracting Officer a statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in complete accordance with the contract plans and specifications and the manufacturer's prescribed procedures and techniques.

3.6 Records. The Contractor will maintain a chronological record throughout the course of the contract of all uncorrected deficiency items.

4. 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 aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place. Polyvinyl Chloride, RTRP and RPMP pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325M.

4.1 Coated and Wrapped Steel Pipe. Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

PART 2 PRODUCTS

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

5.1 Pipe.

5.1.1 Ductile-Iron Pipe. Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be encased with 10 mil thick polyethylene in accordance with AWWA C105. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

5.1.2 Polyvinyl Chloride (PVC) Plastic Pipe. All pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4-Inch Diameter:

(1) Screw-Joint: Pipe to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Pipe couplings when used, must be tested as required by ASTM D 2464.

(2) Elastomeric-Gasket Joint: Pipe shall be to dimensional requirements of ASTM D 1785, Schedule 40 with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

SDR	Maximum Working Pressure	Minimum Hydrostatic Pressure
26	100	133
21	120	160
17	150	200
13.5	200	266

In addition to the above requirements, the pipe, couplings and fittings must be hydrostatically tested as required by AWWA C900, and must be to iron pipe (I.P.S.) or cast iron outside diameter (CIOD) size dimensions.

(3) Solvent Cement Joint: Pipe to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4-Inch through 12-Inch Diameter: Pipe, couplings and fittings 4-inch through 12-inch diameter shall conform to the requirements of AWWA c900, Class 150, CIOD pipe dimensions only, elastomeric-gasket joint only, unless otherwise shown or specified.

5.1.3 Steel Pipe 3 Inches and Larger, Not Galvanized. AWWA C200 with dimensional requirements as given in ANSI B36.10M for pipe 6 inches in diameter and larger, and ASTM A 53 for smaller sizes. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 for use with mechanical couplings or bell-and-spigot ends with rubber gaskets. Bell-and-spigot ends for sizes less than 6 inches diameter shall be as required by AWWA C200.

5.1.4 Protective Materials for Steel Pipe. Protective materials for steel pipe, except as otherwise 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.

a. Steel Pipe 3 Inches or Larger, Not Galvanized:

(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.

(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.

(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.

5.1.5 Filament Wound Reinforced Thermoset Resin Pipe (RTRP-I). Pipe 3 inches and larger shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996. The pipe shall have integral bell and spigot or straight coupled joints.

5.1.6 Centrifugally Cast Reinforced Thermoset Resin Pipe (RTRP-II). Pipe 3 inches or larger shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

5.1.7 Reinforced Plastic Mortar Pressure (RPMP). Pipe 3 inches or larger shall conform to ASTM D 3517.

5.1.8 RTRP I and II RPMP Pipe. Pipe shall have a quick-burst strength equal to or greater than four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

5.2 Joints.

5.2.1 Ductile-Iron Pipe.

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

b. Push-on joints shall conform to AWWA C111.

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

5.2.2 Polyvinyl Chloride Pipe. Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

5.2.3 RTRP-I, Grade 1 and 2. Joints shall be the bell and spigot with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

5.2.4 RTRP-II, Grade 1 and 2. Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

5.2.5 RPMP Pipe. Joints shall be the bell and spigot type with elastomeric gasket or mechanical.

5.2.6 Steel Pipe, Not Galvanized.

a. Mechanical couplings shall be as hereinafter specified.

b. 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.

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

5.2.7 Bonded Joints. Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, 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.

5.2.8 Insulating Joints. 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.

5.3 Fittings and Specials.

5.3.1 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. Ductile iron compact fittings shall be accordance with AWWA C153.

5.3.2 Polyvinyl Chloride (PVC) Pipe. Fittings and specials shall be cast iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with the requirements of AWWA C900. Cast-iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

5.3.3 RTRP Pipe and RPMP Pipe. Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform with MS MIL-P-28584. Cast iron or ductile iron fittings shall be cement-mortar lined in accordance with AWWA C104 and shall conform to AWWA C110 and AWWA C111. Fittings shall be suitable for working and testing pressures specified for the pipe.

5.3.4 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.

5.3.5 Dielectric Fittings. 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.

5.4 Couplings.

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

a. 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.

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

5.5 Valves.

5.5.1 Check Valves. 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, manufacturer's name, initials, or trademark shall be cast on the body of each valve.

a. 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.

b. 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.

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

a. Valves 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.

b. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

5.5.3 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 inches 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.

5.5.4 Pressure Reducing Valves. Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 150 psi operating pressure on the inlet side, with outlet pressure set for 65 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.

5.5.5 Vacuum and Air Relief Valves. 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.

5.6 Miscellaneous Items.

5.6.1 Service Clamps. 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 a rubber gasket cemented to the body.

5.6.2 Corporation Stops. 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.

5.6.3 Goosenecks. Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections be in accordance with standard practice.

5.6.4 Service Stops. 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.

5.6.5 Tapping Sleeves. Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

5.6.6 Service Boxes. 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.

5.6.7 Disinfection. Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

5.6.8 Meters. 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.

5.6.9 Meter Boxes. 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.

PART 3 EXECUTION

6. INSTALLATION.

6.1 Cutting of Pipe. Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type

mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Asbestos-cement pipe shall be cut in accordance with AWWA M16. Squeeze type mechanical cutters shall not be used for ductile iron.

6.2 Adjacent Facilities.

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

6.2.2 Water Lines. Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

6.2.3 Roads. Water pipe shall be encased in a sleeve of rigid conduit for the lengths shown. Where sleeves are required, the pipe sleeve shall be as specified for storm drains in SECTION: STORM-DRAINAGE SYSTEM. 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.

6.2.4 Structures. Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required for roads, railroads, and airfields. 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.

6.3 Joint Deflection.

6.3.1 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 bonds or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

6.3.2 Flexible Plastic Pipe. Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but in no case shall it exceed 5 degrees.

6.3.3 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.

6.4 Placing and Laying. Pipe and accessories shall be carefully lowered into the trench by means of derrick, roses, 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 bc 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.

6.4.1 RTRP Pipe Installation. RTRP pipe shall be installed in accordance with ASTM D 3839. RPMP pipe shall be installed in accordance with the recommendations of the manufacturer. PE and PB shall be installed in accordance with ASTM D 2774. PVC shall be installed in accordance with AWWA M23.

6.4.2 Manufacturer's Field Representative. The representative shall be a person employed by the pipe manufacturer and shall be qualified in all phases of RTRP and RPMP pipe laying and jointing. The name and written qualifications of the manufacturer's field representative shall be submitted to the Contracting Officer prior to commencing installation. The representative shall be present at the job site during the installation and testing to provide technical assistance and to verify that the materials are being installed in accordance with the manufacturer's prescribed procedures. When the representative feels that the Contractor is installing and testing the RTRP and RPMP pipe in a satisfactory manner, he will certify this in writing and note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other conditions which could have an adverse effect on the satisfactory completion and operation of the piping system. Prompt action shall be taken to correct all deficiencies identified by the field representative. In addition, the Contractor shall take prompt action to return to the factory all damaged and defective RTRP and RPMP pipe and fittings and shall order prompt replacement of such materials.

6.4.3 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.

6.4.4 Penetrations. Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

6.4.5 Flanged Pipe. Flanged pipe shall only be installed above ground or with the flanges in valve pits.

6.5 Jointing.

6.5.1 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.

6.5.2 Polyvinyl Chloride (PVC) Plastic Pipe.

a. Pipe Less Than 4-Inch Diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. Care shall be exercised to assure the gasket and ring groove in the bell or coupling match. The manufacturer of the pipe or fitting must also supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall utilize sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4-Inch through 12-Inch Diameter: Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4-inch diameter with configuration utilizing elastomeric ring gasket.

c. Pipe 14-Inch through 36-Inch Diameter: Joints shall be elastomeric-gasket push-on joints made in accordance with AWWA M23.

6.5.3 RTRP I and II and RPMP Pipe.

a. RTRP I: Assembly of the pipe shall be done in strict conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved nor shall additional joints be made until the previously laid joints are completely cured. Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured, The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 1,500 psi or greater when carried out in accordance with ASTM D 1599. All field bonded epoxy-cemented joints, regardless of ambient temperature, shall be cured with a self-regulating thermostatically temperature controlled electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint,

or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating or until the joint has cooled to ambient temperature.

b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.

c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used, spacer rings must be utilized to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 1/8-inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 100 foot-pounds. Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

6.5.4 Steel Pipe, Not Galvanized.

a. Mechanical Couplings: Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

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

6.5.5 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.

6.5.6 Bonded Joints. Bonded joints shall be installed in accordance with details specified for joints under paragraph "MATERIALS."

6.5.7 Insulating Joints. Insulating joints shall be installed in accordance with details specified for joints under paragraph "MATERIALS."

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

6.6 Field Coating and Lining of Pipe.

6.6.1 Steel Pipe 3 Inches and Larger, Not Galvanized.

a. 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.

b. 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.

6.6.2 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.

6.7 Setting of Valves and Valve Boxes.

6.7.1 Valves and Valve Boxes. 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 undisturbed trench face if less than 4 feet.

6.7.2 Valves. 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 valve shall be fully opened and fully closed to insure that all parts are in working condition.

6.7.3 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.

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

6.9 Thrust Restraint. Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 4 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 restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

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

6.9.2 Restrained Joints. For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

7. 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.

7.1 Pressure Test. After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Water lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, 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 walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the 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: SIDE DRAINS, GAGING STATION, MANHOLE, AND MANHOLE ADJUSTMENTS.

7.2 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. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section 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:

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

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 aver*ge 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.

7.3 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.

7.4 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.

a. Pressure test and leakage test may be conducted concurrently.

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

8. DISINFECTION. Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. 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. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. 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.

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

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SECTION 2V

SANITARY SEWERS

Index

PART 1 GENERAL

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

1.1 American Society for Testing and Materials (ASTM).

ASTM A 48	(1983) Gray Iron Castings
ASTM A 123	(1984) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 536	(1984) Ductile Iron Castings
ASTM C 14	(1988) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 94	(1986b) Ready-Mixed Concrete
ASTM C 150	(1989) Portland Cement
ASTM C 270	(1989a) Mortar for Unit Masonry
ASTM C 425	(1988) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1985a) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1988a) Precast Reinforced Concrete Manhole Sections
ASTM C 700	(1988) Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

ASTM C 828 (1988) Low-Pressure Air Test of Vitrified Clay Pipe Lines

1.2 Federal Specifications (FS).

FS RR-F-621 (Rev E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

2. GENERAL REQUIREMENTS. Excavation and backfilling shall conform to SECTION: SIDE DRAINS, GAGING STATION, MANHOLES, AND MANHOLE ADJUSTMENTS. Backfilling shall be accomplished after inspection by the Contracting Officer.

3. SUBMITTALS. The following shall be submitted in accordance with SECTION: SPECIAL CLAUSES:

3.1 Certificates of Compliance. Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes shall be submitted.

PART 2 PRODUCTS

4. PIPE. 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 Concrete Pipe and Specials. Concrete pipe and specials, unless otherwise shown or specified, shall be nonreinforced and conform to ASTM C 14, Class 2. Pipe shall be bell and spigot type. Joints and gaskets shall conform to ASTM C 443.

4.3 Epoxy lined ductile Iron

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

6. FRAMES AND COVERS. 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 FS 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. Covers shall read City of Phoenix Sanitary Sewer

7. LADDERS FOR MANHOLES. 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. 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. 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. 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.

PART 3 EXECUTION

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 primary access road crossings and under buildings, 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 and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted so as to obtain the degree of water tightness required.

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 1 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.

11.2.4 Width of Trench. If the maximum width of the trench at the top of the pipe, as specified in SECTION: SIDE DRAINS, GAGING STATION, MANHOLES, AND MANHOLE ADJUSTMENTS, 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.

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 for concrete pipes shall be as prescribed in ASTM C 828. 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. CONCRETE CRADLE AND ENCASEMENT. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

13. WYE BRANCHES. Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When 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.

14. MANHOLES.

14.1 General. Manholes shall be constructed of glass-fiber-reinforced polyester, concrete or 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 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed 1 foot 6 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels, and drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches.

14.2 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.

14.3 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.

14.4 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.

15. 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.

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

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SECTION 2W

STABILIZED BASE COURSE

PART 1 GENERAL

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

1.1 American Society for Testing and Materials (ASTM).

ASTM C 136	(1984; Rev. a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(1986) Portland Cement
ASTM C 171	(1969; R 1986) Sheet Materials for Curing Concrete
ASTM D 75	(1987) Sampling Aggregates
ASTM D 558	(1982) Moisture-Density Relations of Soil-Cement Mixtures
ASTM D 1556	(1982) Density of Soil In Place by the Sand-Cone Method
ASTM D 1557	(1978) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Lb. [4.54-kg] Rammer and 18-In. [457-mm Drop]
ASTM D 1632	(1987) Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
ASTM D 1633	(1984) Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 1664	(1980; R 1985) Coating and Stripping of Bitumen-Aggregate Mixtures
ASTM D 2028	(1976; R 1986) Cutback Asphalt (Rapid-Curing Type)
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1987) Wire-Cloth Sieves for Testing Purposes

1.2 Federal Specification (FS).

FS CCC-C-467	(Rev. C) Cloth, Burlap, Jute (or Kenaf)

2. DEFINITION. Stabilized base course, as used herein, is a mixture of Portland cement and select borrow material uniformly blended and thoroughly compacted to produce a pavement course which meets all criteria as set forth in the plans and specifications.

3. GENERAL. The work specified herein consists of the construction of a Portland cement-stabilized base course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans.

4. SUBMITTALS. The following shall be submitted in accordance with SECTION: SUBMITTALS:

4.1 Mix Designs (Contractor and Job). Contractor shall develop and submit for approval a proposed mix design prior to start of stabilization work. Mix shall be developed using the aggregate or soil-aggregate material to be stabilized. Mix shall have a minimum compressive strength of 500 psi for base and a weight loss of 14 percent or less after 12 cycles of the durability test.

4.2 Test Reports.

4.2.1 Aggregates. Tests for the evaluation of aggregates shall be made by an approved commercial laboratory at no expense to the Government. Tests for determining the suitability of aggregate shall include, but not be limited to: sieve analysis in accordance with ASTM C 136, using sieves conforming to ASTM E 11, liquid limits and plasticity index in accordance with ASTM D 4318, and stripping in accordance with ASTM D 1664. Certified copies of aggregate test results shall be submitted to the Contracting Officer for approval not less than 15 days before the material is required in the work.

4.3 Calibration curves and related test results shall be submitted prior to using the device or equipment being calibrated.

4.4 Certificates of Compliance.

4.4.1 Bituminous Materials. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements shall be submitted to the Contracting Officer for approval not less than 15 days before the material is required in the work.

4.5 Records.

4.5.1 Aggregates. Sources from which aggregates are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of contract.

4.5.2 Bituminous Materials. Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract.

5. PLANT, EQUIPMENT, MACHINES, AND TOOLS.

5.1 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 be adequate and shall have the capability

of producing the required compaction, meeting grade controls, thickness control and smoothness requirements as set forth herein.

5.2 Central-Plant. The central plant shall be capable of producing a uniform cement-treated mixture at the required cement and moisture contents. Soil and cement shall be dry-mixed sufficiently to prevent cement balls from forming when water is added.

5.3 Straightedge. The Contractor shall furnish and maintain at the site, in good condition, one 10-foot straightedge for each bituminous paver, for use in the testing of the finished surface. Straightedges shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

6. WEATHER LIMITATIONS. Cement shall not be applied when the atmospheric temperature is less than 40 degrees F. No cement shall be applied to soils that are frozen or contain frost, or when the underlying material is frozen. If the temperature falls below 35 degrees F, completed cement-treated areas shall be protected against detrimental effects of freezing. Any areas of completed base that are damaged by freezing, rainfall, or other weather conditions shall be brought to a satisfactory condition in conformance with this specification without additional cost to the Government.

PART 2 PRODUCTS

7. MATERIALS.

7.1 Cement. Cement shall conform to ASTM C 150, Type II, low alkali.

7.2 Bituminous Material. Bituminous material shall be cutback asphalt conforming to ASTM D 2028, Grade MC-70 or MC-250.

7.3 Material to be Stabilized.

7.4 Water. Water shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, and other substances deleterious to the hardening of soil-cement, and shall be subject to approval.

7.5 Burlap. Burlap shall conform to FS CCC-C-467.

7.6 Impervious Sheeting. Sheeting shall conform to ASTM C 171 and shall be white waterproof paper, white opaque polyethylene film or white burlap-polyethylene sheets.

8. SAMPLING AND TESTING.

8.1 General Requirements. Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and as specified to insure that materials and compaction meet specified requirements. Copies of the test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

8.2 Test Results. Results shall verify that materials comply with the specification. When a material source is changed, the new material will be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or repaired to conform to the contract requirements at no additional cost to the Government.

8.3 Samples. Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75. Specimens to be used for unconfined compression tests shall be prepared in accordance with ASTM D 1632 except that a 4-inch diameter by 8-inch high mold shall be used to prepare specimens when more than 35 percent of the material is retained on the No. 4 sieve.

8.4 Initial Sampling and Testing.

8.4.1 Laboratory Density. Moisture-density tests shall be conducted in accordance with the procedure contained in ASTM D 558; however the apparatus and procedures outlined in Methods A or D, of ASTM D 1557 shall be used to compact the soil-cement mixture.

8.4.2 Unconfined Compression Testing. Unconfined compression tests shall be conducted in accordance with ASTM D 1633. Three tests shall be conducted for each mix design tested. Samples shall be cured at a constant moisture content and temperature for 7 days.

8.5 Sieve Analysis. A minimum of one analysis shall be performed for each 500 tons of material to be stabilized, with a minimum of one analysis for each day's run until the course is completed. When the source of materials is changed or deficiencies are found, the analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced at no additional cost to the Government.

8.6 Liquid Limit and Plasticity Index. One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D 4318.

8.7 Sampling and Testing During Construction. Quality control sampling and testing during construction shall be performed as required in paragraph "FIELD QUALITY CONTROL."

PART 3 EXECUTION

9. GENERAL REQUIREMENTS. Cement shall not be applied if the soil moisture content exceeds optimum moisture content specified for the cement-treated mixture. After mixing is completed, the proportions of the mixture shall be in accordance with the approved mix design. When application of water and mixing are completed, on the basis of dry weight, moisture shall not be below the optimum moisture content of the mixture nor shall it be more than 2 percent above the optimum moisture content. When the stabilized course is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire construction period to prevent water from collecting or standing on the areas to be stabilized or on pulverized, mixed, or partially mixed material. Line and grade

stakes shall be provided as necessary for control. Grade stakes shall be placed in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

10. OPERATION OF BORROW PITS. Borrow pits shall be cleared, stripped and excavated to working depth in a manner that produces excavation faces that are as nearly vertical as practicable for the materials being excavated. Strata of unsuitable materials overlying or occurring in the deposit shall be wasted. Methods of operating the pits and the processing and blending of the materials may be changed or modified if necessary to obtain material conforming to the specified requirements. Upon completion of the work, pits shall be conditioned to drain readily, and be left in a satisfactory condition.

11. STOCKPILING MATERIALS. Select material, including approved material available from excavation and grading shall be stockpiled in the manner and at the locations designated. Before stockpiling of material, the storage sites shall be cleared, drained, and leveled. Materials obtained from different sources shall be stockpiled separately.

12. PREPARATION OF AREA TO BE STABILIZED.

12.1 General Requirements. Area shall be cleaned of debris. It shall be inspected for adequate compaction and shall be capable of withstanding without displacement the compaction specified for the soil-cement mixture. Debris and removed unsatisfactory in-place material shall be disposed of as specified.

12.2 In-Place Materials to Receive Stabilized Course. Soft, yielding areas and ruts or other irregularities in the surface shall be corrected. Material in the affected areas shall be loosened and unsatisfactory material removed. Approved select material shall be added where directed. The area shall then be shaped to line, grade, and cross section, and shall be compacted to the specified density. Subgrade shall conform to SECTION: EXCAVATION, EMBANKMENT, AND PREPARATION OF SUBGRADE.

12.3 Select Material. Sufficient select material shall be utilized to provide the required thickness of the soil-cement layer after compaction and shall be processed to meet the requirements specified before cement stabilization is undertaken.

13. INSTALLATION.

13.1 Edges of Stabilized Course. Approved material shall be placed along the edges of the stabilized course in such quantity as will compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 1-foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the stabilized course.

13.2 Central-Plant Method. The mixture shall be hauled to the job in trucks equipped with protective covers. Underlying course shall be thoroughly moistened and the material shall be deposited on the prepared area in such quantity that will produce a compacted base of uniform density to the required grade and cross section. Spreading or spreading-trimming equipment shall be so constructed and operated as to produce a layer of material which is uniform in thickness and surface contour and free from irregularities in density. Spreading or spreading-trimming equipment shall be used in sufficient numbers and operated in staggered formation to obtain full-width spreading in one construction operation. Not more than 60 minutes shall elapse

between the start of the moist mixing and the start of compaction of the treated layer. Not more than 30 minutes shall elapse between the placement of the cement-treated soil in adjacent lanes on two-lane structures at any location.

13.3 Traveling-Plant Method. Traveling plant shall move at a uniform rate of speed and shall accomplish thorough mixing of the materials. Water and cement shall be delivered from supply trucks or bins at a predetermined rate. Windrows of prepared soil-cement mixture shall be of sufficient size to cover a predetermined width to the indicated compacted thickness.

13.4 Layer Thickness. Compacted thickness of the stabilized course shall be as indicated. No layer shall be in excess of 8 inches nor less than 4 inches in compacted thickness.

13.5 Compaction. Before compaction operations are started and as a continuation of the mixing operation, the mixture shall be thoroughly loosened to the full depth. At the beginning of compaction, at least 80 percent of the soil shall pass a No. 4 sieve, and 100 percent shall pass the 1-inch sieve. Compaction shall be started immediately after mixing is completed. Density of compacted soil-cement mixture shall be at least 98 percent of the maximum density obtained from the laboratory prepared samples. Loose mixture shall be uniformly and continuously compacted until the entire depth and width of the area are compacted to the density specified herein. The moisture content at the surface shall be maintained near optimum at all times through the rolling but shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller at all times shall be such that displacement of the mixture does not occur. Areas inaccessible to rollers shall be compacted with mechanical tampers.

14. FINISHING. The surface shall be moistened, if necessary, and shaped to the required lines, grades, and cross section. If necessary, the surface shall be lightly scarified to eliminate any imprints made by the compacting or shaping equipment. The surface shall then be thoroughly compacted to the specified density with rubber-tired rollers and smooth-wheel tandem rollers to the extent necessary to provide a smooth, dense, uniform surface that is free of surface checking, ridges, or loose material, and that conforms to the crown, grade, and line indicated. These finishing operations shall be completed within 2 hours after completion of mixing operations. In places not accessible to finishing and shaping equipment, the mixtures shall be compacted with mechanical tampers to the density specified and shall be shaped and finished by hand methods. Any portion of the compacted mix that has density less than that specified, that has not properly hardened, or that is improperly finished shall be corrected as specified below.

15. CONSTRUCTION JOINTS. At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material. Material along construction joints not properly compacted shall be removed and replaced with soil-cement that is mixed, moistened, and compacted in accordance with this specification. Construction joints, other than as specified herein or indicated on the drawings, shall be approved by the Contracting Officer.

16. CURING AND PROTECTION. The finished surface shall be protected against rapid drying for 7 days by one of the methods specified.

16.1 Burlap. Burlap covers shall consist of two or more layers of burlap having a combined weight of 14 ounces or more per square yard in a dry condition. Burlap shall be new. Burlap strips shall have a length, after shrinkage, at least 1 foot greater than necessary to cover the entire width and edges of the finished stabilized area. Mats shall overlap each other at least 6 inches. Mats shall be thoroughly wetted before placing and shall be kept continuously wet and in intimate contact with the surface and edges of the finished stabilized area for the entire curing period.

16.2 Impervious Sheeting. The surface of the finished stabilized area shall be moistened with a fine spray of water and then covered with impervious sheeting. The burlap of the polyethylene-coated burlap shall be thoroughly saturated with water before placing. Sheeting shall be placed with the light-colored side up. Sheets shall extend over the edges of the stabilized area and shall be held securely in place throughout the curing period. Edges of sheets shall overlap each other at least 12 inches and shall be securely cemented or taped to form continuous closed joints. Tears and holes in sheets shall be repaired immediately.

17. BITUMINOUS MATERIAL. Bituminous material shall be uniformly applied by means of a bituminous distributor within a temperature range of 120 degrees F to 185 degrees F, for MC-70, and within a temperature range of 165 degrees F to 230 degrees F, for MC-250, as directed. Bituminous material for curing shall be uniformly applied at the rate of 0.2 to 0.25 gallon per square yard. Areas inaccessible to or missed by the distributor shall be properly treated using the manually operated hose attachment. Bituminous material shall be applied only to the top layer. At the time the bituminous material is applied, the surface shall be free of loose or foreign matter and shall contain sufficient moisture to prevent excessive penetration of the bituminous material. When necessary, water in sufficient quantity to fill the surface voids shall be applied immediately before the bituminous material is applied.

18. FIELD QUALITY CONTROL.

18.1 Grade Control. Underlying material shall be excavated to sufficient depth for the required stabilized-course thickness so that the finished stabilized course with the subsequent surface course will meet the fixed grade. Finished and completed stabilized area shall conform to the lines, grades, cross section, and dimensions indicated.

18.2 Smoothness Test. The surface of a stabilized layer shall show no deviations in excess of 3/8 inch when tested with the 10-foot straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing new material, or by reworking existing material and compacting, as directed. Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 10-foot straightedge. Measurements shall also be taken perpendicular to the road centerline at 50-foot intervals.

18.3 Thickness Control. The completed thickness of the stabilized course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding mixture of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming with the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The thickness of the stabilized course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of stabilized course. Measurements shall be made in 3-inch diameter test holes penetrating the stabilized course.

18.4 Testing. Field tests shall be performed in sufficient numbers to assure that the specifications are being met. Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial laboratory.

18.5 Field Density. Field density tests shall be performed in accordance with ASTM D 1556. At least one field density test shall be performed for each 250 square yards of each layer of base material.

18.6 Samples of Bituminous Materials. A sample of the bituminous material used will be obtained by the Contractor under the supervision of the Contracting Officer. The sample will be retained by the Government.

18.7 Maintenance. The stabilized area shall be maintained in a satisfactory condition until the completed work is accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Defects shall be remedied as specified herein.

18.8 Traffic. Completed portions of the cement-treated soil area may be opened immediately to light traffic provided the curing is not impaired. After the curing period has elapsed, completed areas may be opened to all traffic provided that the cement-stabilized course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic. Heavy equipment shall not be permitted on the area during the curing period. Cement and water may be hauled over the area with pneumatic-tired equipment as approved. Finished portions of cement-stabilized soil that are traveled on by equipment used in constructing an adjoining section shall be protected in a manner so as to prevent equipment from marring or damaging the completed work.

19. DISPOSAL OF UNSATISFACTORY MATERIALS. Removed in-place materials that are unsuitable for stabilization, material that is removed for the required correction of defective areas, waste material, and debris shall be disposed of as directed.

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SECTION 3A

FORMWORK FOR CONCRETE

Index

1. REFERENCE STANDARDS. 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).

ACI 347	(1978; R 1984) Concrete Formwork

1.2 American Society for Testing and Materials (ASTM) with Corresponding CRD Standard Indicated where Available.

ASTM C 31 (CRD-C 11)	(1988) Making and Curing Concrete Test Specimens in the Field
ASTM C 39 (CRD-C 14)	(1986) Compressive Strength of Cylindrical Concrete Specimens

1.3 U. S. Department of Commerce, National Bureau of Standards (DOC).

DOC PS 1	(1983) Construction and Industrial Plywood

2. SUBMITTALS.

2.1 Shop Drawings. Drawings and computations for all formwork required shall be submitted at least 15 days before either fabrication on site or before delivery of prefabricated forms. The drawings and data submitted shall include the type, size, quantity and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

2.2 Manufacturers Literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, form coating and form lining materials.

2.3 Sample Panels and Posts. After shop drawings have been approved, sample panels and posts for Class A and F finish treatments shall be delivered to the Contracting Officer where directed. At least three sample posts shall be delivered. Panels shall be of sufficient size to contain joints and shall be not less than 6 feet long and 4 feet high. The panels shall be of typical wall thickness. Posts shall be full size. Panels and posts shall be constructed containing the full allocation of reinforcing steel that will be used and with the forming system that duplicates in every detail the one that will be used in construction of the structures. The same concrete mix design and materials, the same placement techniques and equipment, and

the same finishing techniques and timing shall be used that are planned for the posts. Construction of structures with Class A and F finishes will not be permitted until sample panels and posts have been approved. Sample panels and posts shall be protected from construction operations in a manner to protect approved finish and are not to be removed until all Class A and F finish concrete has been accepted.

3. DESIGN. The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. The formwork shall be designed for loads, lateral pressure and allowable stresses in accordance with Chapter 1 of ACI Standard 347. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

4. MATERIALS.

4.1 Forms shall be fabricated with facing materials that produce the specified construction tolerance requirements and the surface requirements of SECTION: CONCRETE.

4.1.1 Class "A" Finish. This class of finish shall apply to 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 DOC PS 1 grade B-B concrete form Class I; tempered concrete hardboard or steel. Steel lining on wood sheathing will not be allowed.

4.1.1.1 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 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.

4.1.1.2 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.

4.1.2 Class "B" Finish. This class of finish shall apply to all surfaces except those specified to receive Class A or those to receive a formed textured finish. The sheathing shall be composed of tongue-and-groove or shiplap lumber, plywood conforming to DOC PS 1 grade B-B concrete form, tempered concrete form hardboard, or steel. Steel lining on wood sheathing will not be permitted.

4.1.3 Class "F" Finish. This class of finish shall apply to those surfaces described in the drawings as "rough lumber finish". This finish is roughly described as Cedar Grapestake and shall have a minimum relief of 5/8 inch. It shall be obtained by use of textured form liners. These liners may be of formed plastic sheet, wood, sheetmetal or other approved material.

4.2 Form Accessories. Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

4.3 Form Coating shall be a commercial formulation of satisfactory and proven performance that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

5. INSTALLATION. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements and conforming to construction tolerance of SECTION: CONCRETE. Where concrete surfaces are to be permanently exposed to view, joints in form panels shall be arranged to provide a pleasing appearance. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. All surfaces of forms and embedded materials shall be cleaned of any mortar from previous concreting and of all other foreign material before concrete is placed in them.

6. CHAMFERING. All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated a sufficient distance outside the limit of the earth or rockfill so that the end of the joints will be clearly visible.

7. COATING. Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

8. REMOVAL. Forms shall not be removed without approval and all removal shall be accomplished in a manner which will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum time indicated below, except as otherwise directed or specifically authorized. When conditions of the work are such as to justify the requirement, forms will be required to remain in place for a longer period.

8.1 Unsupported Concrete. Formwork for walls, columns, sides of beams, gravity structures and other vertical type forms not supporting the weight of concrete shall not be removed in less than 24 hours, except as specified hereinafter. Forms for walls not designed to support any other work may be removed after 16 hours provided the minimum compressive strength exceeds 700 psi for each of two compressive strength cylinders tested in accordance with ASTM C 31 and C 39. The time depends on temperature, lift heights and type and amount of cementitious material in the concrete. Where forms for columns, walls and sides of beams also support formwork for slabs or beam soffits, the removal time of the latter shall govern.

8.2 Supported Concrete. Pan joist forms of the type which can be removed without disturbing shoring shall not be removed in less than 4 days. Supporting forms and shoring shall not be removed until structural members have acquired sufficient strength to support safely their own weight and any construction load to which concrete may be subjected. In no case shall forms and shoring be removed until both minimum time and sufficient strength have been attained.

	Concrete Mixtures Containing Type II or Type IP cement	Concrete Mixtures Containing Type II cement with flyash
Joist, beams or girder soffits or covered channel section top slab where clear structural span between support is:		
under 10 feet	4	6
10 to 20 feet	7	10
over 20 feet	14	21

In addition to minimum times in days specified above, results of control tests conducted in accordance with ASTM C 31 and C 39 will be used as evidence that concrete has attained sufficient strength to permit removal of forms. Concrete cylinders shall be stored in the structure or as near the structure as possible, shall receive insofar as possible the same curing and protection as given those portions of the structure they represent, and shall be tested within 12 hours after removal from the structure. Cylinders will be tested by and at the expense of the Contractor. The Contracting Officer shall either witness the tests or shall receive written certification from the Contractor attesting to the strengths of the test specimens at least 4 hours prior to form removal, or by 4 p.m. of the day preceding, if the Contractor elects to commence form removal prior to noon. Supporting forms shall not be removed until after the minimum time specified above and control test specimens have attained at least 80 percent of strength required for the structure in accordance with quality and location requirements of SECTION: CONCRETE.

9. FIELD QUALITY CONTROL. Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. Forms for walls may be removed after 16 hours, provided that 2 compressive strength cylinders tested in accordance with ASTM C 31 and C 39 each has a compressive strength greater than 700 psi. The cylinders will be fabricated and tested by the Contractor in the presence of the Contracting Officer. The results of each inspection shall be reported in writing.

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SECTION 3B

EXPANSION, CONTRACTION AND CONSTRUCTION
JOINTS IN CONCRETE

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

1.1 American Society for Testing and Materials (ASTM) Standards. (With corresponding U.S. Army Corps of Engineers Handbook for Concrete and Cement (CRD) Specifications where indicated.)

ASTM D 1751 (CRD-C 508)	(1983) Performed Expansion Joint Filler for Concrete Paving and Structural Construction Nonextruding and Resilient Bituminous Types)
ASTM D 1752 (CRD-C 509)	(1984) Preformed Sponge Rubber and Cork Expansion Joint Fillers and Concrete Paving and Structural Construction
ASTM D 1850	(1974; R 1979) Concrete Joint Sealer, Cold-Application Type
ASTM D 3406	(1985) Joint Sealant, Hot Applied, Elastomeric Type, for Portland Cement Concrete Pavements

1.2 Federal Specification (FS).

FS TT-S-00227	(Rev E; Am 3) Sealing Compound, Elastomeric-Type, Multi-component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

2. SUBMITTALS.

2.1 Test Reports. Certified manufacturer's test reports shall be provided for premolded expansion-joint filler strips, sealers, and lubricant to verify compliance with the applicable specification.

3. MATERIALS.

3.1 Expansion Joint Filler Strips, Premolded shall conform ASTM D 1751 or ASTM D 1752, Type I or resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752

3.2 Joint Sealants and Seals.

3.2.1 Field Molded Sealants shall conform to FS TT-S-00227, Type II for vertical joints and Type I for horizontal joints, Class A; or ASTM D 1850 or D 3406. All sealants shall be tested in bond to 50 percent extension. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, nonshrink, nonreactive with sealant, and nonabsorptive material type such as extruded butyl or polychloroprene foam rubber.

4. INSTALLATION. Joint locations and details, including materials and methods of installation of joint fillers, shall be as specified, shown on the drawings and as directed. Joints shall be provided in the invert slabs of the channel whenever concrete placement is stopped for periods exceeding 45 minutes. In no case shall any fixed metal be continuous through an expansion or contraction joint. In vertical walls and covered channel roof, vertical construction joints shall be provided at intervals of 30 to 60 feet measured along the walls or the centerline of the invert. On curves, the 60-foot maximum interval shall be measured along the channel wall with the greater radius. In no case shall any fixed metal be continuous through an expansion or contraction joint in a vertical wall.

4.1 Expansion Joints. Premolded filler strips shall have oiled wood strips secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces. The wood strips shall be slightly tapered, dressed and of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant or seals to the size shown on the drawings. Material used to secure premolded fillers and wood strips to concrete shall not harm the concrete and shall be compatible with the joint sealant or seals. The wood strips shall not be removed until after the concrete curing period. The groove shall be thoroughly cleaned of all laitance, curing compound, foreign materials, protrusions of hardened concrete and any dust which shall be blown out of the groove with oil-free compressed air.

4.1.1 Joints With Field-Molded Sealant. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degree F. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

4.2 Contraction Joints. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint.

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SECTION 3C

STEEL BARS, STEEL WELDED WIRE FABRIC, AND ACCESSORIES FOR CONCRETE REINFORCEMENT

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 American Concrete Institute (ACI).

ACI 315R	(1980; Rev 1988) Details and Detailing of Concrete Reinforcement
ACI 318	(1983; R 1986) Building Code Requirements for Reinforced Concrete

1.2 American Society for Testing and Materials (ASTM).

ASTM A 184	(1988) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 370	(1988a) Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 497	(1986) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615	(1987a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706	(1988) Low-Alloy Steel Deformed Bars for Concrete Reinforcement

1.3 American Welding Society (AWS).

AWS D1.4	(1979) Structural Welding Code - Reinforcing Steel

2. CERTIFICATION TESTING. The Contractor shall have required material tests performed by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests shall be performed and certified at the Contractor's expense.

2.1 Reinforcement Steel Tests. Mechanical testing of steel shall be in accordance with ASTM A 370 except as otherwise specified herein or required by the material specifications. Tension tests shall be performed on full cross section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. The ladle analysis shall show the percentages of carbon, phosphorous, manganese, and sulfur present in the steel.

3. SUBMITTALS. The Contractor shall submit the following items to the Contracting Officer for approval.

3.1 Shop Drawings shall be in accordance with specified requirements and include the following:

(1) Reinforcement steel schedules showing quantity, size, shape, dimensions, weight per foot and total weights, and bending details.

(2) Details of bar supports showing types, sizes, spacing, and sequence.

(3) Mark designations used on shop drawings shall be the same as on the reinforcement steel contract drawings.

3.2 Test Reports. Certified test reports of reinforcement steel showing that the steel complies with the applicable specifications shall be furnished for each steel shipment and identified with specific lots prior to placement. Three copies of the ladle analysis shall be provided for each lot of steel and the Contractor shall certify that the steel furnished conforms to the ladle analysis.

3.3 Disposition Records. A system of identification which shows the disposition of specific lots of approved materials in the work shall be established and submitted before completion of the contract.

4. MATERIALS.

4.1 Steel bars shall conform to the grade, size, and length shown on the drawings.

4.1.1 Billet-Steel Bars shall conform to ASTM A 615, deformed.

4.1.2 The bend test requirements shall be based upon 180 degree bends of full size bars for all grades of steel. The bend diameters for bend test shall be as indicated in the following table and shall be measured on the inside of bars:

Bar Size	Maximum Diameter
No. 3, 4, and 5	3-1/2 bar diameters
No. 6, 7, and 8	5 bar diameters
No. 9, 10, and 11 (Grade 40)	5 bar diameters

4.1.3 Low-Alloy Bars. ASTM A 706.

4.1.4 Fabricated Bar Mats. ASTM A 184, clipped or welded mats, billet-steel bars specified herein.

4.2 Steel Welded Wire Fabric. ASTM A 497 wire spacing and sizes as indicated on the drawings. For wire with a specified yield strength (fy) exceeding 60,000 psi, fy shall be the stress corresponding to a strain of 0.35 percent.

4.3 Accessories.

4.3.1 Bar Supports. ACI 315. Supports for formed surfaces exposed to view or to be painted shall be plastic protected wire, stainless steel, or precast concrete supports. Precast concrete supports shall be wedge-shaped, not larger than 3-1/2 x

3-1/2 inches, of thickness equal to that indicated for concrete cover, and have an embedded hooked tie-wire for anchorage. If formed surface is exposed to view, precast concrete supports shall be the same quality, texture, and color as the finish surface.

4.3.2 Wire Ties shall be 16-gage or heavier black annealed wire.

5. PLACEMENT. Reinforcement steel and accessories shall be placed as specified and as shown on contract drawings and approved shop drawings. Placement details of steel and accessories not specified or shown on the drawings shall be in accordance with ACI 315 and ACI 318 or as directed by the Contracting Officer. Steel shall be fabricated to shapes and dimensions shown, placed where indicated within specified tolerances, and adequately supported during concrete placement. At the time of concrete placement all steel shall be free from loose, flaky rust, scale (except tight mill scale), mud, oil, grease, or any other coating that might reduce the bond with the concrete. No cutting of reinforcing steel by torch will be allowed without approval of the Contracting Officer.

5.1 Hooks and Bends. Steel may be mill or field bent. All steel shall be bent cold unless otherwise authorized. No steel bars shall be bent after being partially embedded in concrete unless indicated on the drawings or otherwise authorized.

5.2 Welding of steel will be permitted only where indicated on the drawings or as otherwise directed by the Contracting Officer. Welding shall be performed in accordance with AWS D1.4 except where otherwise specified or indicated on the drawings.

5.3 Placing Tolerances.

5.3.1 Spacing. The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than one inch.

5.3.2 Concrete Cover. The minimum concrete cover of main reinforcement steel shall be as shown on the drawings. The allowable variation for minimum cover shall be as follows:

Minimum Cover	Variation
6"	+ 1/2"
4"	+ 3/8"
3"	+ 3/8"
2"	+ 1/4"
1-1/2"	+ 1/4"
1"	+ 1/8"
3/4"	+ 1/8"

5.4 Splicing. Splices in steel shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Government, subject to the approval of the Contracting Officer.

5.4.1 Lap Splices shall be used only for bars smaller than Size No. 14 and welded wire fabric. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches.

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SECTION 3D

STRESSING TENDONS AND ACCESSORIES
FOR PRESTRESSED CONCRETE

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 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO-01	(1983; 13th Ed; Int Specifications - Bridges 1984, 1985, 1986, 1987, 1988) Standard Specifications for Highway Bridges

1.2 American Society for Testing and Materials (ASTM).

ASTM A 416	(1988b) Steel Strand, Uncoated Seven-Wire Stress-Relieved for Prestressed Concrete
ASTM C 109	(1988) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
ASTM C 150	(1989) Portland Cement
ASTM C 939	(1981) Flow of Grout for Preplaced-Aggregate Concrete
ASTM C 940	(1981) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

2. QUALITY CONTROL. Requirements for material tests, workmanship and other measures for quality control shall be as specified and shown on the drawings. The Contractor shall provide continuous inspection of all operations for quality control and record the results for submitting to the Contracting Officer to show compliance with contract requirements. The Contractor's facilities shall be open for inspection by the Contracting Officer at any time.

3. SUBMITTALS. Shop drawings, samples, lists of materials, certified materials test reports, disposition records, descriptions and certifications of prestressing method and equipment, prestressing technician certification, prestressing records, Contractor's quality control reports and other required submittals shall be submitted by the Contractor to the Contracting Officer for approval as specified herein.

3.1 Shop Drawings. Shop drawings shall show complete details including type and size of prestressing elements and anchorages, erection methods and details, sequence of stressing and complete stressing calculations.

3.2 Materials Test Reports. Certified materials test reports shall be submitted for all required material tests, note the specific standards followed in the performance of tests, show that materials comply with the applicable specifications, be submitted for each material shipment and be identified with specific lits prior to use of materials in the work.

3.3 Disposition Records. Records which show the disposition of specific lots of approved tested materials in the work shall be compiled and submitted before completion of the contract.

3.4 Descriptions and Certifications of Prestressing Method and Equipment. Descriptions of the proposed prestressing method and equipment should indicate the manufacturer of all components and include tensioning jacks, gauges, dynamometers and load cells or other devices for measuring stressing loads. Calibration records for each set of jacking equipment and testing curves for stress measurement gauges which show that the gauges have been calibrated for the jacks for which they are to be used shall be certified. Descriptions and certifications must be approved prior to the start of the prestressing operations.

3.5 Prestressing Technician Certification. Certificates for prestressing technicians should list the names of the technicians who will use the proposed prestressing system in the work and certify that the technicians are thoroughly trained and skilled in the use of the proposed system.

3.6 Prestressing Records. Complete prestressing records shall be compiled and submitted after the work is completed. These records shall show the manufacturer, identification and description of materials and equipment including prestressing tendons and jacking and load measuring equipment; location of prestressing tendons; initial design tensioning loads, final design tensioning loads and actual tensioning loads for tendons; dates tensioning loads applied; and theoretical and actual elongations for tendons.

4. DELIVERY, STORAGE AND HANDLING OF MATERIALS. Materials shall be suitably wrapped, packaged or covered at the factory or shop to prevent being affected by dirt, water and rust. Materials shall be protected against abrasion or damage during shipment and handling. Materials stored at the site shall be placed above ground on elevated, covered platforms.

5. MATERIALS. Stressing tendons and accessories shall conform to the requirements of AASHTO-01 except as specified herein.

5.1 Stressing Tendons shall be clean and free of loose rust, scale and pitting. Unbonded tendons shall be permanently protected from corrosion with an approved applied coating.

5.1.1 Seven-Wire Stress-Relieved Strand and Strand Assemblies. ASTM A 416, Grade 270, Low Relaxation, strand diameter as shown on drawings. Strand assemblies may be either shop or field assembled with anchor fittings positively attached to strands.

5.2 Ducts. Tendon ducts shall be of ferrous metal, capable of transmitting forces from grout to the surrounding concrete, flexible enough to conform to the tendon profile and strong enough to maintain their shape without deforming, sagging or collapsing during concrete placement and vibration. The inside diameter of ducts shall be large enough to provide an internal area at least twice the gross area of multiple wire, bar or strand assemblies and at least 1/4-inch larger than the diameter of a single wire, bar or strand placed in the ducts. Ducts shall be designated for watertight connections with all fittings. Galvanized ducts will not be permitted.

5.3 Anchorages and Couplers. Anchorages and couplers shall be metal of proven corrosion resistance and compatibility with the stressing tendons, capable of fully developing the minimum guaranteed ultimate strength of tendons without excessive slip and approved by the Contracting Officer. Anchorages shall be the button-head, wedge, nut and thread, grip nut, thread-bar, threaded plate or other approved type and shall be provided with bearing plates bars, rings, bells or other positive-attaching anchor fittings. Couplers shall be provided with housings long enough to permit the necessary movements and fittings which allow complete grouting of all components.

5.4 Grout for grouting post-tensioned tendons shall consist of a mixture of Portland cement, shrinkage compensating admixture and potable water of which final proportions shall be based on test results of sample mixtures. Cement shall conform to ASTM C 150, Type II. The shrinkage compensating admixture shall produce a 2 percent minimum and a 10 percent maximum unconfined expansion when tested in accordance with ASTM C 940, shall not contain aluminum powder, chlorides, fluorides or nitrates, may be dispensed in solid or lquied form and must be approved by the Contracting Officer prior to its use. The water content shall be the minimum necessary for proper placement but the water-cement ratio shall not exceed 0.50 by weight. The pumpability of grout shall be determined in accordance with ASTM C 939. The efflux time of a grout sample immediately after mixing shall not be less than 11 seconds. The minimum 7-day compressive strength of 2-inch grout cubes molded, cured and tested in accordance with ASTM C 109 shall be 2,500 psi.

6. INSTALLATION. Stressing tendons and accessories shall be installed as specified and as shown on contract and approved shop drawings. Installation details of stressing tendons and accessories not specified or shown on the drawings shall be in accordance with AASHTO-01. Welding shall not be performed near or adjacent to stressing tendons. Stressing tendons shall not be installed until all welding has been completed on supports or any part which might be in contact with the tendons.

6.1 Anchorages. Anchorages must be set in a plane normal to the axis of the tendons such that uniform bearing on the concrete is assured. Positive connecting anchorages rather than gripping types shall be used for anchoring embedded ends of tendons. Anchorages and anchor fittings shall be permanently protected against corrosion. Parallel wire anchorage wedges or cores shall be recessed within the members.

6.2 Stressing Tendons and Ducts. Protective coverings and wrappings shall be removed and each stressing tendon shall be closely inspected to see that nicks, scoring, pits or other damage does not exist and high strength steel bars shall be closely inspected to assure that they are not bent and that threaded ends are in satisfactory condition immediately prior to installation. Strand, wire and bar tendons shall be shop or field assembled as required and positively attached to anchorages. Type WA wire assemblies shall be anchored only with wedge type anchorages. Stressing tendons and ducts shall be assembled to required shapes and dimensions and placed where indicated on drawings within specified tolerances and adequately supported. Ducts shall be securely fastened at close intervals and grout openings and vents must be securely anchored to ducts and to either the forms or reinforcing steel to prevent displacement

during concrete placing. The ends of ducts shall be effectively protected to prevent entry of water, concrete, grout or debris. Wires of parallel-wire assemblies shall not be spliced. Steel bar tendons may be joined by couplers where shown on the drawings or approved by the Contracting Officer provided they are capable of developing the gruaranteed minimum ultimate strength of the bars. Strands to be spliced shall have the same lay or direction of twist and the ends shall be cut by shears or abrasive grinders. No more than one strand shall be spliced in any one member where single strand tensioning is employed. Strand splices shall be capable of developing the full ultimate strength of the strand. Slippage of the splice shall be checked and corection made for differential slippage. Where multiple strand tensioning is used not more than 10 percent of the strands in any member shall be spliced.

6.3 Tensioning Tendons. Tensioning of stressing tendons shall be as specified and shown on the drawings. The stress induced in the tendons by any method of tensioning shall be determined independently by both (1) measurement of tendon elongation and (2) direct measurement of force using a pressure gauge or load cell. If the results of these two measurements do not check each other and the theoretical values within 5 percent the operation shall be carefully checked and the source of error determined and corrected before proceeding further. Concrete cylinder tests shall indicate a breaking strength of at least 4,510 pounds per square inch before transfer of stress to ensure that the concrete strength is adequate for the requirements of the anchorages or for transfer through bond as well as meet camber or deflection requirements. The final prestress load in each unit after seating shall be as shown on the drawings. Safety measures shall be taken by the Contractor to prevent accidental injury caused by failure of a stressing tendon or tendon component. The exposed ends of stressing tendons and anchorages shall be protected from damage during stressing operations to prevent failure.

NOTE: DETERMINATION OF THE INITIAL PRESTRESS FORCE MUST CONSIDER PRESTRESS LOSSES IN ACCORDANCE WITH AASHTO-01

6.3.1 Pretensioning. Strand tendons may be tensioned by jacking of groups of strands or may be tensioned individually by means of a single-strand jack. Before final tensioning of tendons, all tendons shall be brought to a uniform initial tension of approximately 1,000 pounds per strand per 200 feet of bed, with a minimum of 1,000 pounds and a maximum of 3,000 pounds per strand. The force corresponding to the initial tension shall be measured by a dynamometer or other approved method to aid in determining the final elongation. After this initial tensioning, the tendons shall be stressed to the total tension indicated on the drawings using hydraulic or mechanical equipment with gauges or dynamometers graduated and calibrated to accurately determine the load applied. Draped pretensioned strands shall be tensioned partially by jacking at the end of the bed and partially by uplifting or depressing strands, or they shall be held in their draped positions by means of rollers, pins or other approved methods and tensioned entirely by jacking. Approved low-friction devices shall be used at all points of change in slope of draped strands while tensioning draped strands, regardless of the tensioning method used. Cable stress shall be maintained between anchorages until the concrete has reached the specified compressive strength.

6.3.2 Detensioning. Forces from pretensioned strands shall be transferred to the concrete by either the multiple-strand release or the single-strand release method. The stress transfer shall not be performed until concrete strength, as indicated by test cylinders, has reached the specified transfer strength. If concrete has been heat-cured, the detensioning shall be done immediately following the curing period while the concrete is still warm and moist. During detensioning, the prestressing

forces shall be kept nearly symmetrical about the vertical axis of the member and shall be applied in a manner that will minimize sudden loading. Eccentricity about the vertical axis shall be limited to one strand.

6.3.2.1 Multiple-Strand Release. In this method, all strands shall be detensioned simultaneously and the load transferred gradually to the concrete by hydraulic jacking.

6.3.2.2 Single-Strand Release. In this method, all strands shall be detensioned by slow heat-cutting the strands in accordance with a pattern and schedule as approved by the Contracting Officer. The strands shall be heated using a low-oxygen flame until the metal gradually loses its strength, causing release of the strands to occur gradually. The low-oxygen flame shall be played along the strand for a minimum of 5 inches. Strands shall be so heated that the failure of the first wire in each strand will occur after the torch has been applied for a minimum of 5 seconds.

6.3.3 Post-tensioning. Tensioning shall not be performed until the concrete has reached the required strength at transfer of stress. Before final tensioning of tendons, all tendons shall be brought to a uniform initial tension of approximately 10 percent of the full load. The force corresponding to the initial tension shall be measured by a dynamometer or other approved method as a starting point in determining final elongation. A temporary overstress above the final prestress force shall be used, as approved by the Contracting Officer, to overcome stress losses. The units shall be tensioned until the proper elongations and jacking pressures are attained and reconciled within the limits stated above. Straight tendons may be tensioned from one end. Curved or draped tendons shall be stressed by simultaneous jacking from both ends using a common pump with identical hoses and jacks, unless otherwise provided on the drawings.

6.4 Grouting Post-Tensioned Tendons. Grouting between each tendon and its enclosing duct shall be performed within 5 days after completion of the tensioning operation, except that grouting shall not be performed if air temperature below 45 degrees F. is anticipated within 48 hours after grouting unless an approved method of temperature control is used. The grout shall be mixed in a mechanical mixer of a type that will produce uniformly and thoroughly mixed grout. Water shall be first placed in the mixer followed by cement and admixture. Grout shall be continuously agitated until it is pumped. Grout that has begun to set shall be discarded. Just before grouting, the ducts shall be flushed with clean water and then blown clear by compressed air to removed excess water. With the grout vent open at one end of duct, grout shall be applied continuously under moderate pressure at the other end until all entrapped air is forced out as indicated by a uniform flow of grout from the discharge vent. The discharage vent shall then be closed and the pressure raised to 50 psi minimum and held for a least 1 minute. The injection point shall then be closed by an approved means to prevent any loss of grout. For a period of at least 3 days after grouting the tendons, the prestressed members shall not have equipment or other loads placed on them. A longer period may be required, depending upon the method of curing and magnitude of imposed stresses.

6.5 Accuracy of Stress and Elongation Measurement.

6.5.1 Stress Measurement. Hydraulic gauges, dynamometers, load cells or other devices for measuring stressing load shall have an accuracy of reading within two percent. Gauges shall be calibrated for the jacks for which they are used. Recalibration shall be performed at any time that a gauging system shows indication

of erratic results in the opinion of the Contracting Officer and, in any case, at intervals not greater than 12 months. Gauges shall indicate loads directly in pounds or be accompanied by a chart which converts dial readings into pounds.

6.5.2 Elongation Measurement. After the initial force has been applied to a tendon, reference points for measuring elongation due to additional tensioning forces shall be established. They will be located according to the method of tensioning and type of equipment. The system used shall be capable of measuring the true elongation ±1/16-inch.

* * * * *

SECTION 3E

CONCRETE

Index

1. REFERENCE STANDARDS. 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).

ACI 211.1 (CRD-C 99)	(1981; R 1985) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

1.2 American Society for Testing and Materials (ASTM) with Corresponding CRD Standard Indicated Where Available.

ASTM C 31 (CRD-C 11)	(1988) Making and Curing Concrete Test Specimens in the Field
ASTM C 33 (CRD-C 133)	(1986) Concrete Aggregates
ASTM C 39 (CRD-C 14)	(1986) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 70 (CRD-C 111)	(1979; R 1985) Surface Moisture in Fine Aggregate
ASTM C 94 (CRD-C 31)	(1989b) Ready-Mixed Concrete
ASTM C 136 (CRD-C 103)	(1984a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143 (CRD-C 5)	(1989a) Slump of Hydraulic Cement Concrete
ASTM C 150 (CRD-C 201)	(1989) Portland Cement
ASTM C 171 (CRD-C 310)	(1969; R 1986) Sheet Materials for Curing Concrete

ASTM C 172 (CRD-C 4)	(1982) Sampling Freshly Mixed Concrete
ASTM C 192 (CRD-C 10)	(1988) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231 (CRD-C 41)	(1989a) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260 (CRD-C 13)	(1986) Air-Entraining Admixtures for Concrete
ASTM C 494 (CRD-C 87)	(1986) Chemical Admixtures for Concrete
ASTM C 566 (CRD-C 113)	(1984) Total Moisture Content of Aggregate by Drying
ASTM C 595 (CRD-C 203)	(1986) Blended Hydraulic Cements
ASTM C 618 (CRD-C 255)	(1989) Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 1077	(1987) Laboratory Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation
ASTM D 75 (CRD-C 155)	(1987) Sampling Aggregates
ASTM E 329 (CRD-C 500)	(1977; R 1983) Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

1.3 Concrete Plant Manufacturer's Bureau (CPMB).

CPMB-01 (CRD-C 95)	(6th Edition) Concrete Plant Standards

1.4 U.S. Army Corps of Engineers Handbook for Cement and Concrete (COE).

COE CRD-C 100	(1975) Sampling Concrete Aggregate and Aggregate Sources and Selection of Material for Testing
COE CRD-C 104	(1980) Calculation of the Fineness Modulus of Aggregate
COE CRD-C 112	(1969) Surface Moisture in Aggregate by Water Displacement

COE CRD-C 143	(1962) Meters for Automatic Indication of Moisture in Fine Aggregate
COE CRD-C 300	(1988) Membrane-Forming Compounds for Curing Concrete
COE CRD-C 400	(1963) Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 621	(1989) Non-Shrink Grout

1.5 National Bureau of Standards (NBS).

NBS Handbook 44	(4th Edition 1971 with Replacement Sheets) Specifications, Tolerance and Other Technical Requirements for Commercial Weighing and Measuring Devices

2. QUALITY ASSURANCE.

2.1 Preconstruction Sampling and Testing.

2.1.1 Aggregates. The aggregate sources listed in SPECIAL CLAUSES have in the past been determined to be capable of supplying aggregates of quality acceptable for use in this project. Proposed aggregates produced from similar strata, or of similar quality, will be approved. If the Contractor proposes to furnish aggregates from a source listed in SPECIAL CLAUSES, he will be required to supply not less than 1000 pounds of each size coarse aggregate and 1000 pounds of fine aggregate taken from the proposed source under the supervision of the Contracting Officer in accordance with COE CRD-C 100 and shall deliver them to:

Director
South Pacific Division Laboratory
U.S. Army Corps of Engineers
Bridgeway, Foot of Spring Street
(Building directly east of 2000 Bridgeway)
Sausalito, CA 94695
Phone: (415) 332-3374

within 15 days after notice to proceed. Sampling and shipment of samples shall be at the Contractor's expense. The laboratory will require 45 days after delivery of the samples to complete evaluation of the aggregates. Testing by and at the expense of the Government will be in accordance with the applicable CRD or ASTM test methods. Tests to which aggregate may be subjected are specific gravity, absorption, freezing-and-thawing in concrete, alkali-aggregate reaction, organic impurities and any other test necessary to demonstrate that the aggregate is of a quality which is at least equivalent to those sources listed in SPECIAL CLAUSES. If the Contractor proposes to furnish aggregates from a source not listed in SPECIAL CLAUSES, samples will be obtained as described above. The aggregates' suitability for use in concrete will be determined by the Government. The division laboratory will require 60 days after delivery of the samples to evaluate the aggregates. If the source selected by the

Contractor fails to supply materials that are at least equivalent to the sources listed in SPECIAL CLAUSES, as determined by the Government, the Contractor will be required to propose a new source or elect a source listed in SPECIAL CLAUSES to supply aggregates for the project. If the Contractor elects to obtain aggregates from more than one source, samples of aggregates from each source to be evaluated will be obtained as described above. Any testing of additional sources or retesting of sources which fail initially, will be at the expense of the Contractor. The Government reserves the right to reject materials found to be unsuitable when produced from any source even a source that is noted in SPECIAL CLAUSES. Regardless of the source selected, the Contractor will be required to submit samples as described for verification testing. A period of 45 days will be required to perform the verification testing.

2.1.2 Cementitious Materials, Admixtures, Curing Compound. At least 60 days in advance of concrete placement the Contractor will notify the Contracting Officer of the source of materials, along with sampling location, brand name, type and quantity to be used in the manufacture and/or curing of the concrete. Sampling and testing will be performed by and at the expense of the Government except as otherwise specified. No material shall be used until notice has been given by the Contracting Officer that test results are satisfactory and all movement of materials after sampling shall be as directed. The Government will sample and test the following.

2.1.2.1 Cement and Pozzolan. If cement or pozzolan is to be obtained from more than one source, the initial notification shall state the estimated amount to be obtained from each source and the proposed schedule of shipments.

2.1.2.2 Prequalified Cement Sources. Cement shall be delivered and used directly from a mill of a producer designated as a qualified source. Samples of cement for check testing will be taken at the project site or concrete producing plant by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified cement sources is available from Commander and Director, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi 39180.

2.1.2.3 Prequalified Pozzolan Sources. Pozzolan shall be delivered and used directly from a producer designated as a qualified source. Samples of pozzolan for check testing will be taken at the project site by a representative of the Contracting Officer for testing at the expense of the Government. A list of prequalified pozzolan sources is available from the Commander and Director, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180.

2.1.2.4 Cement, if not from a prequalified source will be sampled at the source and stored in sealed bins pending completion of certain tests. Sampling, testing and the shipping inspection from the point of sampling, when the point is other than at the site of the work, will be made by, or under the supervision of the Government and at its expense. No cement shall be used until notice has been given by the Contracting Officer that test results are satisfactory. In the event of failure, the cement may be resampled and tested at the request of the Contractor, at his expense. When the point of sampling is other than at the site of the work, the fill gates of the sampled bin and conveyances used in shipment will be sealed under Government supervision and kept sealed until shipment from the bin has been completed. If tested cement is rehandled at transfer points the extra cost of inspection will be at the Contractor's expense. The cost of testing cement excess to the project requirements will also be at the expense of the Contractor. The charges for testing cement at the expense of the Contractor will be deducted from the payments due the Contractor at a rate of $1.20 per ton of cement represented by the tests.

2.1.2.5 Pozzolan, if not from a prequalified source, will be sampled at the source and stored in sealed bins pending completion of certain tests. Pozzolan will also be sampled at the site when determined necessary. All sampling and testing will be by and at the expense of the Government. Release for shipment and approval for use will be based on compliance with 7-day lime-pozzolan strength requirements and other physical and chemical and uniformity requirements for which tests can be completed by the time the 7-day lime-pozzolan strength test is completed. Release for shipment and approval for use on the above basis will be contingent on continuing compliance with the other requirements of the specifications. If a bin fails, the contents may be resampled and tested at the Contractor's expense. In this event the pozzolan may be sampled as it is loaded into cars, trucks or barges provided they are kept at the source until released for shipment. Unsealing and resealing of bins and sealing of shipping conveyances will be done by or under the supervision of the Government. Shipping conveyances will not be accepted at the site of the work unless received with all seals intact. If pozzolan is damaged in shipment, handling, or storage, it shall be promptly removed from the site of the work. Pozzolan which has not been used within six months after test will be retested at the expense of the Contractor when directed by the Contracting Officer and shall be rejected if the test results are not satisfactory. If tested pozzolan is rehandled at transfer points, the extra cost of inspection will be at the Contractor's expense. The cost of testing excess pozzolan will be at the Contractor's expense at a rate of $2.00 per ton of pozzolan represented by the tests. The amount will be deducted from payment to the Contractor.

2.2 Construction Testing By Government. The Government will sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143 and ASTM C 231, respectively. Compression test specimens will be made and laboratory cured in accordance with ASTM C 31 and compression test specimens tested in accordance with ASTM C 39.

3. EVALUATION AND ACCEPTANCE.

3.1 Concrete Strength. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equal or exceed the required specified strength f'c and no individual test result falls below the specified strength f'c by more than 500 pounds per square inch. Additional analysis or testing may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient. Concrete work judged inadequate shall be reinforced with additional construction as directed by the Contracting Officer or shall be replaced at the Contractor's expense.

3.2 Construction Tolerances. Variation in alignment, grade and dimensions of the structures from the established alignment, grade and dimensions shown on the drawings shall be within the tolerances specified in the following tables:

TABLE I. TOLERANCES FOR CONCRETE CHANNEL WALLS, INVERTS, AND SPILLWAYS.

(1)	Departure from established alignment	.....	2-inches on tangents
		.....	4-inches on curves
(2)	Departure from established profile grade	.....	1-inch

(3)	Footings:		
	a. Variation of dimensions in plan	Minus.....	1/2-inch
		Plus..... when formed or plus 3-inches when placed against unformed excavation.	2-inches
	b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 2-in.	
	c. Reduction in thickness	Minus.....	5 percent of specified thickness
(4)	Reduction in thickness in lining or walls	.....	10 percent of specified thickness: provided that average thickness is maintained as determined by daily batch volumes
(5)	Variation from specified width of channel section at any height	.....	1/4 of 1 percent plus 1-inch
(6)	Variation from established height of lining	.....	1/2 of 1 percent plus 1-inch
(7)	Variations in surfaces:		
	a. Invert	.....	5/16-inch in 10 feet
	b. Side slopes and walls	.....	1/2-inch in 10 feet

TABLE II. TOLERANCES FOR COVERED CHANNEL, EROSION PROTECTION STRUCTURES, AND SMALL HYDRAULIC STRUCTURES

(1)	Departure from established alignment	.....	1-inch
(2)	Departure from established grades	.....	1-inch
(3)	Variation from the plumb or the specified batter in the lines and surfaces of columns, piers, walls, and in arises	Exposed, in 10 feet...	1/2-inch
		Backfilled, in 10 feet	1-inch
(4)	Variation from the level or from the grades indicated on the drawings in slabs, beams, horizontal grooves, and railing offsets	Exposed, in 10 feet...	1/2-inch
		Backfilled, in 10 feet	1-inch

(5)	Variation in cross-sectional dimensions of columns, piers, slabs, walls, beams, and similar parts	Minus..... Plus.....	1/4-inch 1/2-inch
(6)	Variation in thickness of bridge slabs	Minus..... Plus.....	1/8-inch 1/4-inch
(7)	Variation in the sizes and locations of slab and wall openings	.....	1/2-inch

3.2.1 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 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 paragraph: TEST PANEL.

3.3 Surface Requirements. The surface requirements for the classes of finish required by SECTION: FORMWORK FOR CONCRETE, shall be as hereinafter specified. Allowable irregularities are designated "abrupt" or "gradual" for purposes of providing for surface variations. Offsets resulting from displaced, misplaced or mismatched forms, or sheathing, or by loose knots in sheathing, or other similar form defects, shall be considered "abrupt" irregularities. Irregularities resulting from warping, unplaneness or similar uniform variations from planeness, or true curvature, shall be considered "gradual" irregularities. "Gradual" irregularities will be checked for compliance with the prescribed limits with a 5-foot template, consisting of a straightedge for plane surfaces and a shaped template for curved or warped surfaces. In measuring irregularities, the straight edge or template may be placed anywhere on the surface in any direction, with the testing edge held parallel to the intended surface.

Class of Finish	Irregularities Abrupt, inches	Gradual, inches
A	1/8	1/4
B	1/4	1/2
F	1/8	1/4

3.4 Appearance. Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by a method which does not harm the concrete and which is approved by the Contracting Officer.

4. SUBMITTALS.

4.1 Test Reports.

4.1.1 Concrete mixture proportions shall be determined by the Contractor and submitted for approval. The proportions of all ingredients and nominal maximum coarse aggregate size that will be used in the manufacture of each quality of concrete shall be stated. Proportions shall indicate weight of cement and water and weights of aggregates in a saturated surface-dry condition. The submission shall be accompanied by test reports from a laboratory complying with ASTM c 1077 which show that proportions thus selected will produce concrete of the qualities indicated. No

substitution shall be made in the source or type of materials used in the work without additional tests to show that the new materials and quality of concrete are satisfactory.

4.1.2 Cement and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which it is furnished. Certification and mill test reports shall identify the particular lot furnished. No cement or pozzolan shall be used until notice of acceptance has been given by the Contracting Officer. Cement and pozzolan will be subject to check testing from samples obtained at the mill, at transfer points or at the project site, as scheduled by the Contracting Officer, and such sampling will be by or under the supervision of the Government at its expense. Material not meeting specifications shall be promptly removed from the site of work.

4.1.3 Non-shrink Grout.

4.1.3.1 General. Descriptive literature of the grout proposed for use shall be furnished together with a certificate from the manufacturer stating that it is suitable for the application or exposure for which it is being considered. In addition, a detailed plan shall be submitted for approval, showing equipment and procedures proposed for use in mixing and placing the grout.

4.1.3.2 Prepackaged material requiring only the addition of water will be accepted on the basis of certified laboratory test results showing that the material meets the requirements of COE CRD-C 621. When fine aggregate is to be added, the Contractor shall also furnish for approval the design mix proportions together with certified copies of laboratory test results indicating that the mix is in conformance with the requirements of COE CRD-C 621.

4.1.3.3 Mixture proportions using a volume-change controlling ingredient shall be submitted for approval. The submittal shall include the design mix proportions of all ingredients and certified copies of laboratory test results indicating that the materials and the mix is in conformance with the requirements of COE CRD-C 621.

4.2 Manufacturers' Certificate.

4.2.1 Accelerating Admixture shall be certified for compliance with all specification requirements.

4.2.2 Impervious Sheet Curing Materials shall be certified for compliance with all specification requirements.

4.2.3 Air-entraining Admixture shall be certified for compliance with all specification requirements.

4.2.4 Water-reducing Admixture shall be certified for compliance with all specification requirements.

4.2.5 Color Admixture shall be certified to be non-fading by the manufacturer.

4.3 Review of Plant, Equipment and Methods.

4.3.1 Batch Plant. Details of the data on concrete plant shall be submitted for review by the Contracting Officer for conformance with paragraph: BATCHING PLANT.

4.3.2 Concrete Mixers. The make, type and capacity of concrete mixers proposed for mixing concrete shall be submitted for review by the Contracting Officer for conformance with paragraph: MIXERS. The results of the initial mixer uniformity tests as required in paragraph: MIXER UNIFORMITY shall be submitted within five days of the initiation of placing.

4.3.3 Conveying Equipment. The methods and equipment for transporting, handling, and depositing the concrete shall be submitted for review by the Contracting Officer for conformance with paragraph: CONVEYING EQUIPMENT.

4.3.4 Placing. All placing equipment and methods shall be submitted for review by the Contracting Officer for conformance with paragraph: PLACING.

4.3.5 Joint Clean-up. The method and equipment proposed for joint clean-up and waste disposal shall be submitted for review by the Contracting Officer for conformance with paragraph: CONSTRUCTION JOINT TREATMENT.

4.3.6 Curing. The curing medium and methods to be used shall be submitted for review by the Contracting Officer for conformance with paragraph: CURING AND PROTECTION.

4.3.7 Cold-Weather Requirements. If concrete is to be placed under cold weather conditions, the proposed materials, methods and protection shall be submitted in accordance with the requirements of paragraph: COLD WEATHER PLACING for approval by the Contracting Officer.

4.3.8 Hot-Weather Requirements. If concrete is to be placed under hot weather conditions, the proposed materials and methods shall be submitted in accordance with the requirements of paragraph: HOT WEATHER PLACING for approval by the Contracting Officer.

5. MATERIALS.

5.1 Cementitious Materials shall be Portland cement, Portland-pozzolan cement, or Portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Usage for architectural concrete shall be restricted to one color and one type.

5.1.1 Portland Cement. ASTM C 150, Type II including false set requirements. Low alkali.

5.1.2 High-Early-Strength Portland Cement. ASTM C 150, Type III with tricalcium aluminate limited to 8 percent, low alkali, used only when specifically approved in writing.

5.1.3 Portland-Pozzolan Cement. ASTM C 595 Type IP (MS). The Portland cement or clinkers shall meet the requirements of ASTM C 150 for low alkali cement; the pozzolan shall meet the requirements of ASTM C 618 Table 1, available alkali.

5.1.4 Pozzolan. Pozzolan shall conform to the requirements of ASTM C 618, Class F with the loss on ignition limited to 6 percent. The optional requirements of Table 2 for available alkalies will be invoked. The optional Table 3 will be invoked except that the mortar expansion at 14 days limit is amended so that the expansion of the mortar is not more than that of the cement acting alone with the selected aggregates.

5.2 Aggregates shall be produced from the sources and under the conditions described in paragraph: QUALITY ASSURANCE. Fine and coarse aggregates shall conform to the grading requirements of ASTM C 33. The nominal maximum size of coarse aggregate shall be as listed in paragraph: COARSE AGGREGATE SIZE.

5.3 Admixtures to be used, when required or permitted shall conform to the appropriate specification listed below:

5.3.1 Air-entraining Admixture. ASTM C 260.

5.3.2 Accelerating Admixture. ASTM C 494, Type C except no calcium chloride will be allowed.

5.3.3 Water-reducing or Retarding Admixtures ASTM C 494, Type A, B or D.

5.3.4 Color Admixture. Color admixture for concrete shall be the product of a manufacturer regularly engaged in the production of colored admixtures for concrete, and shall have a history of at least 2 years of use of the material in a similar environment without substantial fading or deleterious effects on the structural qualities of the concrete. Color admixture must be capable of evenly distributing the color throughout the concrete without segregation or causing irregular concentration of color.

5.4 Curing Materials.

5.4.1 Impervious Sheet Materials shall conform to ASTM C 171, type optional except polyethylene film, if used, shall be white opaque.

5.4.2 Curing Compounds.

5.4.2.1 Curing Compounds for colored concrete to be exposed upon completion of construction shall conform to the requirements of COE CRD-C 300, except that it will be clear non-pigmented.

5.4.2.2 Membrane-Forming Curing Compound COE CRD-C 300, White Opaque. This compound will only be used on the backs of channel walls or other concrete structural elements which will not be exposed to permanent view as approved by the Contracting Officer.

5.5 Water for mixing and curing shall be fresh, clean, drinkable, and free of injurious amounts of oil, acid, salt, and alkali, except that undrinkable water may be used if it meets the requirements of COE CRD-C 400.

5.6 Non-Shrink Grout shall conform to COE CRD-C 621. The type shall be Expansive-Cement.

6. MIXTURE PROPORTIONING.

6.1 Quality and Location. For each portion of the structure, mixture proportions shall be selected so that the following strength and water-cement ratio requirements are met.

6.1.1 Strength. Specified compressive strength f'c for structural elements shall be as follows, except where indicated otherwise:

Compressive Strength @ 28 days, psi	Structure or Portion of Structure
4000 @ 28 days	Covered Channel
3000 @ 28 days	All elements not described below
2500 @ 28 days	Concrete for sidewalks
2000 @ 28 days	Canal bottom
1000 @ 28 days	Dental Concrete

6.1.2 Maximum Water-Cement Ratio. Maximum water cement ratio shall be as follows:

Water-Cement Ratio, by Wt.	Structure or Portion of Structure
None	Dental Concrete
0.45	Concrete for invert, channel walls, and covered channel roof.
0.55	Concrete for structures not described elsewhere.
0.65	Curbs, Gutters, and Sidewalks

6.2 Coarse Aggregate Size. Coarse aggregate shall be ASTM C 33 size No. 467 for invert and footings and shall be ASTM C 33 size No. 57 for all other elements except where indicated otherwise.

6.3 Air Content. Air content as determined by ASTM C 231 shall not exceed 7 percent in all concrete. During the preparation of mix designs the Contractor shall determine the amount of air to be used in the concrete mixtures and this amount will be reported in the mix design submittal. This amount of air will be the sum of the entrapped or naturally entrained air and air entrained by admixtures. Once production of concrete has commenced the amount of air shall not vary more than 1-1/2 percent from the selected air content, nor shall it ever exceed the value stated above.

6.4 Slump. The slump shall be determined in accordance with ASTM C 143 and shall be within the following ranges. Where placement by pump is approved, the slump shall not exceed 6 inches and shall remain within a 3-inch band.

Item	Maximum Slump	Placement Restrictions
Invert and Footings	0-2 inches	No pumping
Vertical Walls and Other Elements	1-4 inches	None

6.5 Concrete Proportioning. Trial design batches and testing requirements for various qualities of concrete specified shall be the responsibility of the Contractor. Samples of approved aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of material other than aggregate shall be representative of those proposed for the project and shall be accompanied by manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on ACI Standard 211.1. The water-cement ratios required in paragraph: MAXIMUM WATER-CEMENT RATIO will be converted to a weight ratio of water to cement plus pozzolan or by weight equivalency as described in ACI Standard 211.1 to determine the maximum allowable water. Trial mixtures shall be designed for maximum permitted slump and

air content. The temperature of concrete in each trial batch shall be reported. For each maximum aggregate size selected at each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength.

6.6 Average Strength. In meeting the water-cement ratio and strength requirements specified in paragraph: QUALITY AND LOCATION above, the selected mixture proportion shall produce an average strength (fcr) exceeding the specified strength f'c by the amount indicated below with a water-cement ratio at or below that specified above. Where a concrete production facility has a large amount of test records, verifying that concrete of the strengths and water-cement ratios specified are being produced, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, including admixtures and colors, quality control procedures, and conditions similar to those expected in the current construction. Changes in materials and proportions within the test records shall not have been more restricted than those for the proposed work and shall represent concrete produced to meet a specified strength or strengths f'c meeting or exceeding that specified for proposed work at or below water-cement ratio specified; and shall consist of at least 30 consecutive tests or two groups of consecutive tests totalling at least 30 tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of f'c.

6.6.1 Required average compressive strength fcr used as the basis for selection of concrete proportions shall be the larger of the equations which follow using the standard deviation as determined above:

$$fcr = f'c + 1.34S \text{ where } S = \text{standard deviation}$$

$$fcr = f'c + 2.33S - 500$$

6.6.2 Where a concrete production facility does not have test records meeting requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation may be established as the product of the calculated standard deviation and a modification factor from the following table:

No. Of Tests*	Modification Factor For Standard Deviation
less than 15	Use table in 6.6.3
15	1.16
20	1.08
25	1.03
30 or more	1.00

* Interpolate for intermediate numbers of tests.

6.6.3 When a concrete production facility does not have field strength test records for calculation of standard deviation the required average strength fcr shall be determined as follows:

If the specified compressive strength f'c is less than 3000 psi,

fcr = f'c + 1000.

If the specified compressive strength f'c is 3000 to 5000 psi,

fcr = f'c + 1200.

6.7 Color. Where concrete is to be colored, the admixture shall be batched in a manner that will ensure that the admixture is completely and thoroughly mixed throughout the concrete. Quantities of admixture added to concrete shall be controlled to avoid variations in color between adjacent placements as well as maintain a consistent coloring throughout the project area.

7. PRODUCTION EQUIPMENT.

7.1 Capacity. The batching and mixing equipment shall have a capacity of at least 100 cubic yards per hour.

7.2 Batching Plant shall conform to the requirements of CPMB-01 and as specified; however, rating plates attached to batch plant equipment are not required.

7.2.1 Equipment. The batching controls shall be semi-automatic or automatic. The semi-automatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The semi-automatic or automatic batching system shall be equipped with an accurate recorder or recorders which meet the requirement of the Concrete Plant Standards of CPMB. Separate bins or compartments shall be provided for each size group of aggregate and cement and pozzolan. Aggregates shall be weighed either in separate weigh batchers with individual scales or cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cement, or pozzolan. If both cement and pozzolan are used they may be batched cumulatively provided Portland cement is batched first. If measured by weight, water shall not be weighed cumulatively with another ingredient. Water batcher filling and discharging valves shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. An accurate mechanical device for measuring and dispensing each admixture shall be provided. Each dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and discharged automatically in a manner to obtain uniform distribution throughout the batch in the specified mixing period. Where use of truck mixers make this requirement impracticable, the admixture dispensers shall be interlocked with the sand batcher. Admixtures will not be combined prior to introduction in water or sand. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment.

7.2.2 Weighing Equipment. The weighing equipment shall conform to the applicable requirements of NBS Handbook 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and

any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the frequency required in paragraph: SCALES and in the presence of a Government inspector.

7.2.3 Batching Tolerances.

7.2.3.1 Weighing Tolerances. Whichever of the following tolerances is greater shall apply, based on required scale reading:

Material	Percent of Required Weight	Percent of Scale Capacity
Cementitious Materials	1	0.3
Aggregate	2	0.3
Water	1	0.3
Admixture	3	0.3

7.2.3.2 Volumetric Tolerances. For volumetric batching equipment the following tolerances shall apply to the required volume of material being batched:

Water: Plus or minus 1 percent.

Admixtures: Plus or minus 3 percent.

7.2.4 Moisture Control. The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates, and to change the weights of the materials being batched. An electric moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measuring of moisture in the fine aggregate. The sensing element shall be arranged so that measurement is made near the batcher charging gate of the sand bin or in the sand batcher.

7.3 Mixers.

7.3.1 General. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

7.3.2 Concrete Plant Mixers shall be tilting, non-tilting, horizontal shaft or vertical-shaft type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the paragraphs in ASTM C 94 applicable to central-mixed concrete.

7.3.3 Truck Mixers. Truck mixers, the mixing of concrete therein, and concrete uniformity, shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

8. CONVEYING EQUIPMENT.

8.1 General. Concrete shall be conveyed from mixer to forms as rapidly as practicable and within the time interval in paragraph: TIME INTERVAL BETWEEN MIXING AND PLACING by methods which will prevent segregation or loss of ingredients. Any concrete transferred from one conveying device to another shall be passed through a hopper which is conical in shape and shall not be dropped vertically more than five feet, except where suitable equipment is provided to prevent segregation and where specifically authorized. Telephonic or other satisfactory means of rapid communication between the mixing plant and the forms in which concrete is being placed shall be provided and available for use by Government inspectors.

8.2 Buckets. The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum size aggregate and the area of the gate opening shall be not less than two-square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically or hydraulically operated except for buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

8.3 Transfer Hoppers. Concrete may be charged into non-agitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles, and have conical-shaped discharge features. The machine shall be equipped with a hydraulically-operated gate and with a means of external vibration to effect complete and facile discharge. Concrete shall not be held in non-agitating transfer hoppers more than 30 minutes.

8.4 Trucks. Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Non-agitating equipment may be used for transporting plant mixed concrete over a smooth road when hauling time is less that 15 minutes. Bodies of non-agitating equipment shall be smooth, watertight, metal containers equipped with gates that will permit the discharge of the concrete.

8.5 Chutes. When concrete can be placed directly from a truck mixer, agitator or non-agitating equipment, the chutes attached to this equipment may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete except when specifically approved.

8.6 Belt Conveyors. Belt conveyors may be used when approved. Such conveyors shall be designed and operated to assure uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall meet the additional requirements as follows: The idler spacing shall not exceed 36 inches. If concrete is to be placed through installed horizontal or sloping reinforcing bars the conveyor will discharge concrete into a pipe or elephant trunk which is long enough to extend through the reinforcing bars. In no case will concrete be discharged to free fall through the reinforcing bars.

8.7 Pump Placement. Concrete may be conveyed by positive displacement pump when approved. Invert and side slope concrete will not be pumped. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid steel pipe or

heavy duty flexible hose. The inside diameter of the pipe shall be at least three times the nominal maximum size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. The maximum size coarse aggregate will not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the concrete pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

9. PREPARATION FOR PLACING.

9.1 Embedded Items. Before placing concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids.

9.2 Concrete on Earth Foundations. Earth/cemented alluvium surfaces upon which concrete is to be placed shall be clean, damp, and free from frost, ice, and standing or running water. Prior to placing concrete, the earth/cemented alluvium foundation shall have been satisfactorily compacted in accordance with the requirements of the SECTION: FILLS AND SUBGRADE PREPARATION. Additionally, the foundation shall be inspected by the Contractor prior to concrete placement in order to certify that it is ready to receive concrete. The results of each inspection shall be submitted in writing.

9.3 Concrete on Rock Foundation. Rock surfaces upon or against which concrete is to be placed shall be prepared as specified in the SECTION: FILLS AND SUBGRADE PREPARATION. All rock surfaces shall be kept continuously wet for at least 24 hours immediately prior to placing concrete thereon.

9.3.1 Dental Concrete. Dental concrete shall be low slump, 3/4 inch aggregate, and 1000 psi minimum strength or as directed to produce a satisfactory mixture consistent with placing requirements for foundation surface treatment as determined by the Contracting Officer.

9.4 Construction Joint Treatment.

9.4.1 General. Concrete surfaces to which other concrete is to be bonded shall be prepared for receiving the next lift or adjacent concrete by cleaning with either air-water cutting, sandblasting, high pressure water jet, or other approved method.

9.4.2 Cleaning.

9.4.2.1 Air-Water Cutting. Air-water cutting of a construction joint shall be performed at the proper time and only on horizontal construction joints. The surface shall be cut with an air-water jet to remove all laitance and to expose clean, sound fine aggregate, but not so as to undercut the edges of the larger particles of aggregate. The air pressure used in the jet shall be 100 psi plus or minus 10 psi and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. The surface shall

again be washed just prior to placing the succeeding lift. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, sandblasting will be required as the last operation before placing the next lift.

9.4.2.2 High-Pressure Water Jet. A stream of water under a pressure of not less than 3000 psi may be used for cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse aggregate particles. Where the cleaning occurs more than two days prior to placing the next lift or where work in the area subsequent to the cleaning causes dirt or debris to be deposited on the surface, the surface shall be cleaned again as the last operation prior to placing the next lift. If the water jet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

9.4.2.3 Sandblasting. When employed in the preparation of construction joints, sandblasting shall be performed as the final operation completed before placing the following lift. The operation shall be continued until all accumulated laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall then be washed thoroughly to remove all loose materials. The surface shall again be washed just prior to placing the succeeding lift.

9.4.2.4 Waste Disposal. The method used in disposing of waste water employed in cutting, washing and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. Method of disposal shall be subject to approval.

9.4.2.5 Surface Condition. The surface of the lift shall be damp at the time placement of the next lift and shall be free of standing water.

10. PLACING.

10.1 General. Concrete placement will not be permitted when, in the opinion of the Contracting Officer, weather conditions prevent proper placement and consolidation. Concrete shall be deposited as close as possible to its final position in the forms, and in so depositing there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it may be effectively consolidated in horizontal layers 1-1/2 feet or less in thickness with a minimum of lateral movement. The amount deposited in each location shall be that which can be readily and thoroughly consolidated. The surfaces of construction joints shall be kept continuously wet for the first twelve hours during the twenty-four hour period prior to placing concrete. Free water shall be removed prior to placement of concrete. Sufficient placing capacity shall be provided so that concrete placement can be kept plastic and free of cold joints while concrete is being placed.

10.2 Time Interval Between Mixing and Placing. Concrete shall be placed within thirty minutes after discharge into non-agitating equipment. When concrete is truck mixed or when a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours after introduction of the cement to the aggregates. When the length of haul makes it impossible to deliver truck mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site. Not more than 80 percent of the water and all other materials except cement shall be batched at the distant batch plant and transported to the cement batcher without mixing.

10.3 Cold-Weather Placing. Concrete shall not be placed without a procedure approved in accordance with paragraph: COLD WEATHER REQUIREMENTS when the concrete is likely to be subjected to freezing temperatures before the expiration of the curing period. The ambient temperature of the space adjacent to the concrete placement and surfaces to receive concrete shall be above 32 degrees F. The placing temperature of the concrete having a minimum dimension less than 12 inches shall be between 55 degrees F. and 75 degrees F. The placing temperature of the concrete having a minimum dimension greater than 12 inches shall be between 50 degrees and 70 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperatures. Materials entering the mixer shall be free from ice, snow or frozen lumps. Salt, chemicals or other materials shall not be mixed with the concrete to prevent freezing, except that a chemical accelerator may be used.

10.4 Hot-Weather Placing. Concrete shall be properly placed and finished with approved procedures in accordance with paragraph: HOT-WEATHER REQUIREMENTS. The concrete placing temperature shall not exceed 85 degrees F. Cooling of the mixing water and/or aggregates will be required to obtain an adequate placing temperature. An approved retarder may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete placing temperature.

10.5 Consolidation. Immediately after placing, each layer of concrete shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required if necessary with internal vibrating along formed surfaces permanently exposed to view. Form or surface vibrators shall not be used. Consolidation shall proceed independently of all other placing operations. Vibrators for consolidation shall not be attached to Bidwell Type or any other screeding or leveling equipment selected by the Contractor. Vibrators of the proper size, frequency and amplitude shall be used for the type of work being performed in conformance with the following requirements:

Application	Head Diameter (inches)	Frequency VPM	Amplitude (inches)
Thin walls, beams, etc.	1-1/4 - 2-1/2	9000 - 13500	0.02 - 0.04
General construction	2 - 3-1/2	8000 - 12000	0.025 - 0.05

The frequency and amplitude shall be within the range indicated in the table above as determined in accordance with paragraph: VIBRATORS. The vibrator shall be inserted vertically at uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if such exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly. Spare vibrators and a standby power source shall be available at all times during concrete placement.

11. FINISHING.

11.1 Unformed Surfaces.

11.1.1 General. The ambient temperature of spaces adjacent to surfaces being finished shall not be less than 50 degrees F. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305, may reasonably be expected to exceed 0.2 pounds per square feet per hour, provision for

windbreaks, shading, fog spraying, or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

11.1.2 General. The ambient temperature of spaces adjacent to surfaces being finished shall be not less than 50 degrees F. All unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, unless a steel trowel finish is specified, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to elevation shown on the drawings and left true and regular. Exterior surfaces shall be sloped for drainage unless otherwise shown on the drawing or as directed. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions.

11.1.3 Float Finish. A float finish shall be applied to channel invert and side slopes. Surfaces shall be screeded and darbied or bull-floated to bring the surface to the required finish level with no coarse aggregate visible. No cement or mortar shall be added to the surface during the finishing operation. The concrete, while still green, but sufficiently hardened to bear a man's weight without deep imprint, shall be floated to a true and even plane. Floating may be performed by use of suitable hand floats or power driven equipment. Hand floats shall be made of magnesium or aluminum. Tolerance for a floated finish shall be true plane within 5/16-inch in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

11.1.4 Trowel Finish. A steel trowel finish shall be applied to the following surfaces: spillways, tops of channel walls, and as indicated on the drawings. Concrete surfaces shall be finished with a float finish and after surface moisture has disappeared, the surface shall be steel-troweled to a smooth, even, dense finish free from blemishes including trowel marks. Tolerance shall be true planes within 5/16-inch in ten feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

11.1.5 Broom Finish shall be applied to the traffic surface of all bridges and to the surfaces indicated on the drawings. The concrete surface shall be finished with a float finish and trowel finish. The troweled surface shall be broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

11.2. Formed Surfaces. After form removal, all fins and loose materials shall be removed. All voids, and honeycombs exceeding 1/2 inch in diameter and all tie rod holes permanently exposed to view shall be reamed or chipped and filled with dry pack mortar. Defective areas larger than 36 square inches in any surface, permanently exposed or not shall be delineated in a rectangular shape by a saw cut a minimum depth of one-inch and repaired with concrete replacement. The cement used in the mortar or concrete for all surfaces permanently exposed to view shall be a blend of Portland Cement, white cement, and coloring agent properly proportioned so that the final color when cured will be the same as adjacent concrete. Temperature of the concrete, ambient air, replacement concrete or mortar during remedial work including curing shall be above 50 degrees F. The prepared area shall be dampened, brush-coated with a neat cement grout or with an approved epoxy resin, and filled with mortar or concrete. The mortar shall consist of 1 part cement to 2-1/2 parts fine aggregate. The quantity of mixing water shall be the minimum necessary to obtain a uniform mixture and permit placing. Mortar shall be thoroughly compacted in place and struck off to adjacent concrete. Replacement concrete shall be drier than the usual mixture and thoroughly tamped into place and finished. Forms shall be used if required.

Metal tools shall not be used to finish permanently exposed surfaces. All repairs shall be completed within 24 hours of form removal. The patched areas shall be cured for 7 days.

11.2.1 General. Surfaces, unless other type of finish is specified, shall be left with the texture imparted by the forms except defective surfaces shall be repaired as described above. Unless painting of surfaces is required, uniform color shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure which is exposed to view or on which a special finish is required. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects which would impair the quality of the surface.

11.2.2 Textured Finish. This type of finish shall be applied where specified to conform to details shown on the drawings by use of approved textured form liners. Liner panels shall be secured in the forms by cementing or stapling, but not by methods which will permit impressions of nail heads, screw heads, washers or the like to be imparted to the surface of the concrete. Edges of textured panels shall be sealed to each other to prevent grout leakage. The sealant used shall be non-staining to the surface.

12. CURING AND PROTECTION.

12.1 General. All concrete shall be cured by an approved method for a period of 7 days. Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, and mechanical injury. All materials and equipment needed for adequate curing and protection shall be available and at the placement site prior to start of concrete placement. Concrete shall be protected from the damaging effects of rain for 12 hours, flowing water for 14 days (7 days with type III cement). Concrete shall be shielded from direct rays of the sun for 3 days. Channel wall faces cured with clear curing compound shall be shielded from direct rays of the sun by the use of opaque sheets conforming to the requirements of ASTM C 171. The sheets will be white opaque. No vehicular traffic shall be allowed on invert or footing concrete until a period of 28 days has passed or until the concrete has reached the specified design strength. The strength of the slabs shall be determined by a pair of cylinder breaks performed by the Contractor at the desired age. No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. Concrete will be cured in accordance with the following requirements:

CURING REQUIREMENTS

Structural Element	Method
Invert and Footings, Covered Channel Roof	Moist Cure or Sheet Cure
Side Slopes	Moist Cure or Sheet Cure
Vertical Walls and Other Elements	Any method described below

12.2 Moist Curing. Concrete moist-cured shall be maintained continuously (not periodically) wet for the entire curing period. If water or curing materials stain or discolor concrete surfaces which are to be permanently exposed, they shall be

cleaned as required in paragraph: APPEARANCE. When wooden form sheathing is left in place during curing, the sheathing shall be kept wet at all times. Horizontal surfaces shall be cured by ponding, by covering with a minimum uniform thickness of 2 inches continuously saturated sand, or by covering with saturated non-staining burlap or cotton mats. Horizontal construction joints may be allowed to dry for twelve hours immediately prior to placing of the following lift.

12.3 Membrane Curing. Concrete may be cured with an approved curing compound in lieu of moist curing except that membrane curing will not be permitted on any surface to which sack rubbed finish is to be applied, or any surface containing protruding steel reinforcement, or on abrasive aggregate finish.

12.3.1 A White Pigmented Type Curing Compound conforming to COE CRD-C 300 may be used on surfaces which will not be exposed to view when the project is completed, or on surfaces that are to be painted.

12.3.2 The Curing Compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. The surfaces shall be thoroughly moistened with water and the curing compound applied as soon as free water disappears. The curing compound shall be applied to unformed surfaces as soon as free water has disappeared. The curing compound shall be applied in a 2-coat continuous operation, having the applications at right angles to each other, and applied by approved motorized power-spraying equipment and at a uniform coverage of not more than 400 square feet per gallon for each coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage herein specified. All concrete surfaces on which the curing compound has been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic and from any other cause which will disrupt the continuity of the curing membrane.

12.3.3 A tinted curing compound conforming to the requirements of paragraph: MATERIALS may be used on all surfaces exposed to view, except those to which a moist or sheet cure must be applied.

12.4 Impervious-Sheet Curing. The following concrete surfaces may be cured using impervious sheets: channel invert or side slopes. All surfaces shall be thoroughly wetted and be completely covered with waterproof paper, polyethylene film or with polyethylene-coated burlap having the burlap thoroughly water-saturated before placing. Covering shall be laid with light colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

12.5 Cold Weather. When the daily outdoor low temperature is less than 32 degrees F., the temperature of the air and forms in contact with the concrete shall be maintained above 40 degrees F. for at least the first seven days and above 32 degrees F. for the remainder of the required curing period. In addition, during the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F. as determined by observation of ambient and concrete temperatures. Curing compounds shall not be used on concrete surfaces which are maintained at curing temperature by use of free steam.

13. SETTING OF BASE PLATES AND BEARING PLATES.

13.1 General. After being plumbed and properly positioned, column base plates, shall be provided with full bearing with damp-pack bedding mortar except where non-shrink grout is approved or required. The space between the top of concrete or masonry bearing surface and the bottom of the plate shall be approximately 1/24 of the width of the plate, but not less than 1/2 inch for plates less than 12 inches wide. Concrete surfaces shall be rough, clean, free of oil, grease, and laitance, and shall be damp. Metal surfaces shall be clean and free of oil, grease, and rust.

13.2 Damp-pack bedding mortar shall consist of one part Type I Portland Cement and 2-1/2 parts of fine aggregate conforming to ASTM C 33, proportioned by weight, and not more than 4-1/2 gallons of water per bag of cement. The space between the top of the concrete or masonry bearing surface and the bottom of the plate shall be packed with the bedding mortar by tamping or ramming with a bar or rod until the voids are completely filled. Mortar shall be colored to match adjacent concretes.

13.3 Non-shrink grout shall conform to the requirements of paragraph: NON-SHRINK GROUT. For clearance of two inches or more, the mix shall include by weight 1-1/2 parts of sound, clean uncrushed gravel conforming to Size No. 8, Table 2, ASTM C 33 in combination with fine aggregate conforming to ASTM C 33, to one part Portland Cement unless otherwise recommended by the material manufacturer. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength. Non-shrink grout exposed to view shall be colored to match adjacent concrete.

13.3.1 Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or masonry bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for retaining the grout and shall be removed after the grout has set. The placed grout shall be worked to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 degrees to 85 degrees F. until after setting.

13.3.2 Treatment of Exposed Surfaces. Those types containing metallic aggregate shall have, after the grout has set, the exposed surfaces cut back one inch and immediately covered with a parge coat of mortar proportioned by weight one part Portland Cement, two parts sand, and sufficient water to make the mixture placeable. The parge coat shall have a smooth, dense finish. The exposed surface of other types of non-shrink grout shall have a smooth, dense finish.

13.3.3 Curing. Grout and parge coats shall be cured in conformance with paragraph: CURING AND PROTECTION.

14. CONTRACTOR QUALITY CONTROL.

14.1 General. The Contractor shall perform the inspection and tests described in paragraph: INSPECTION DETAILS AND FREQUENCY OF TESTING, and based upon the results of these inspections and tests he shall take the action required in paragraph: ACTION REQUIRED and submit reports as required in paragraphs: ACTION REQUIRED and REPORTS.

The laboratory performing the tests shall conform to ASTM E 329. The individuals who sample and test concrete or the constituents of concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of concrete Field Testing Technicians, Grade I.

14.2 Inspection Details and Frequency of Testing.

14.2.1 Fine Aggregate.

14.2.1.1 Grading. At least once during each shift in which concrete is being delivered, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104, respectively, for the fine aggregate or for each fine aggregate, if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits.

14.2.1.2 Moisture Content. There shall be, when in the opinion of the Contracting Officer the electric moisture meter is not operating satisfactorily, at least four tests for moisture content in accordance with either ASTM C 70, C 566, or COE CRD-C 112 during each 8-hour period of mixing plant operation. The times for the tests shall be selected randomly within the 8-hour period. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman. When the electric moisture meter is operating satisfactorily, at least two direct measurements of moisture content shall be made per week to check the calibration of the meter.

14.2.2 Coarse Aggregate.

14.2.2.1 Grading. At least once during each shift concrete is being delivered, there shall be a sieve analysis in accordance with ASTM C 136 for each size group of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor is responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken shall show the results of the 5 most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than at the batch plant bins to allow for degradation during handling.

14.2.2.2 Moisture Content. A test for moisture content of each size of coarse aggregate in accordance with ASTM C 566 or COE CRD-C 112 shall be made at least once a shift. When two consecutive readings for smallest size coarse aggregate differ by more than 1.0 percent, frequency of testing shall be increased to that specified for fine aggregate in paragraph: MOISTURE CONTENT, of subparagraph: FINE AGGREGATE. These results shall be used to adjust the added water in the control of the batch plant.

14.2.3 Deleterious Substances. When in the opinion of the Contracting Officer, a problem exists in connection with deleterious substances in fine or coarse aggregates, tests shall be made in accordance with ASTM C 33. Testing frequency shall be not less than one per week.

14.2.4 Scales.

14.2.4.1 Weighing Accuracy. The accuracy of the scales shall be checked by test weights at least once a month for conformance with the applicable requirements of paragraph: WEIGHING EQUIPMENT. Such tests shall also be made whenever there are variations in properties of the fresh concrete which could result from batching errors.

14.2.4.2 Batching and Recording Accuracy. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight and the actual weight batched. The Contractor shall provide the necessary calibration devices and confirm that the admixture dispensers described in paragraph: EQUIPMENT are operating properly.

14.2.5 Batch-Plant Control. When the concrete plant is operating the measurement of all constituent materials including cement, pozzolan, each size of aggregate, water and admixtures shall be continuously controlled. The aggregate weights and amount of added water to compensate for free moisture in the aggregates shall be adjusted as necessary. The amount of air-entraining admixture shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batched aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

14.2.6 Concrete.

14.2.6.1 Air Content. At least two tests for air content shall be made on randomly selected batches of each class of concrete during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231. The average of each set of two tests shall be plotted on a control chart on which the average is set at the percentage specified by the Contractor on his mix design submittal and the upper and lower control limits shall be 1-1/2 percent of the specified air content respectively. The range shall be plotted on a control chart on which the upper control limit is 3.0 percent.

14.2.6.2 Slump. At least two slump tests shall be made on randomly selected batches of each mixture of concrete during each day's concrete production in accordance with ASTM C 143. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. The average of each set of two tests shall be plotted on a control chart. The range shall be plotted on a control chart on which the upper control limit is 3.0 inches.

14.2.6.3 Batch Tickets. The manufacturer of the concrete shall furnish to the Contracting Officer with each batch of concrete, before unloading at the site, a delivery ticket prepared in accordance with the requirements of ASTM C 94.

14.2.7 Preparation for Placing. Foundation or construction joints, forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer it is ready to receive concrete. The results of each inspection shall be reported in writing no less than 2 hours prior to placement or by 4:00 p.m. for placements prior to 9:00 a.m. the following day.

14.2.8 Placing. The placing foreman shall supervise all placing operations, shall determine that the correct quality of concrete or grout is placed in each location as directed by the Contracting Officer and shall be responsible for measuring and recording concrete temperatures, ambient temperature, weather conditions, time of placement, yardage placed, and method of placement.

14.2.9 Vibrators. The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete holding the tachometer against the upper end of the vibrator while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type and size of the vibrator and frequency and amplitude results shall be reported in writing.

14.2.10 Curing.

14.2.10.1 Moist Curing. At least once every 8 hours an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

14.2.10.2 Curing Compound. No curing compound shall be applied until it has been verified that the compound is properly mixed and ready for spraying. At the end of each operation the quantity of compound used and the area of concrete surface covered shall be reported and the rate of coverage in square feet per gallon shall be computed. The report shall state whether coverage is uniform.

14.2.10.3 Impervious Sheet Curing. At least once each shift an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

14.2.11 Protection. At least once each shift an inspection shall be made of all areas subject to cold weather protection. Deficiencies shall be noted. During removal of protection, measurement of concrete and ambient temperature shall be made at least hourly.

14.2.12 Mixer Uniformity.

14.2.12.1 Concrete Plant Mixer. At the start of concrete placing, and at least once every six months when concrete is being placed, uniformity of concrete shall be determined. The tests shall be performed in accordance with ASTM C 94. Whenever adjustments in mixer or increased mixing times are necessary because of failure of any mixer to comply, the mixer shall be retested after adjustment. Results of tests shall be reported in writing.

14.2.12.2 Truck Mixers. At the start of concrete placing and at least once every three months when concrete is being placed, uniformity of concrete shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of blades may be regarded as satisfactory. Results of tests shall be reported in writing.

14.3 Action Required.

14.3.1 Fine Aggregate.

14.3.1.1 Grading. When the amount passing any sieve is outside the specification limits, the fine aggregate shall immediately be resampled and retested. If there is another failure on any sieve, the fact shall immediately be reported to the Contracting Officer, and immediate steps shall be taken to rectify the situation.

14.3.1.2 Moisture. Whenever the moisture content of the fine aggregate changes by 0.5 percent or more, the scale settings for the fine aggregate batcher and water batcher shall be adjusted directly or by means of a moisture compensation device.

14.3.2 Coarse Aggregate.

14.3.2.1 Grading. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall immediately be resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. When two consecutive averages of 5 tests are outside of specification limits, that fact shall be reported to the Contracting Officer and immediate steps shall be taken to correct the grading.

14.3.3 Deleterious Substances. When the results for a deleterious substance is outside the specification limit, the aggregate shall be resampled and retested for the deleterious substance that failed. If the second sample fails, that fact shall be reported to the Contracting Officer. When material finer than No. 200 sieve for coarse aggregate exceeds the specification limit, immediate steps, such as washing or other corrective actions, shall be initiated.

14.3.4 Weighing Accuracy. Whenever either the weighing accuracy or batching accuracy is found not to comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

14.3.5 Concrete.

14.3.5.1 Air Content. Whenever points on the control chart approach the upper or lower control limits an adjustment should be made in the amount of air-entraining admixture batched. If a single test result is outside the specification limit such adjustment is mandatory. As soon as practical after each adjustment another test shall be made to verify the correctness of the adjustment. Whenever a point fails above the upper control limit for range, the dispenser shall be calibrated to insure that it is operating correctly and with good reproducibility. Whenever two consecutive points either for average or range are outside the control limits, the Contracting Officer shall be notified. Whenever the air content departs from the specified range, the concrete shall not be delivered to the forms.

14.3.5.2 Slump. Whenever points on the control chart approach the upper or lower control limits an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total free water does not exceed that amount specified in the approved mixture proportions based on the free water available with the fine aggregate and that amount of water batched. If the adjustments to the batch weights or water and fine aggregate do not satisfactorily produce the required slump the mixture shall be re-proportioned to meet the specified criteria and re-submitted to the Contracting Officer for approval. When a single slump is outside the control limits such adjustment is mandatory. As soon as

practical after each adjustment another test shall be made to verify the correctness of the adjustment. Whenever the slump exceeds the upper limit stipulated in paragraph: SLUMP of subparagraph: MIXTURE PROPORTIONING the concrete shall not be delivered to the forms. Whenever two consecutive slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range above the upper control limit, the slump shall be considered to be out of control and the additional testing for aggregate moisture content required in paragraph: INSPECTION DETAILS AND FREQUENCY OF TESTING shall be undertaken.

14.3.5.3 Test Panel. The Contractor shall place a test panel for each colored concrete specified with a minimum dimension of 6 feet by 6 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 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 shall 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 panels do not conform to 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 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 materials and disposed of in accordance with SECTION: GENERAL REQUIREMENTS. Additionally, test panels will be constructed to document the quality of the color of the tinted curing compound. The test panel will be constructed of any of the proposed colored concrete mixes to be supplied by the Contractor. The curing compound will be applied to the panels in conformance with the paragraph: CURING AND PROTECTION. After a period of 3 days, the color of the exposed concrete surfaces will be evaluated to assure that the color of the curing compound as applied to the concrete conforms to the requirements of the paragraph: COLOR.

14.3.6 Placing. The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators in working order and with competent operators are available. Placing shall not be continued if any pile is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

14.3.7 Curing.

14.3.7.1 Moist Curing. When a daily inspection report lists an area of inadequate curing, the required curing period for that area shall be extended by one day.

14.3.7.2 Curing Compound. When the coverage rate of curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

14.3.7.3 Impervious Sheet Curing. When a daily inspection report lists any tears, holes or laps of joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by one day.

14.3.8 Protection. When any concrete temperature during the period of protection or protection removal fails to comply with the specifications, that fact shall be reported to the Contracting Officer and immediate steps should be taken to correct the situation.

14.3.9 Mixer Uniformity. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased or adjustments shall be made to the mixer until compliance is achieved.

14.4 Reports. All results of tests conducted at the project site shall be reported as required. Each report shall include the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

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SECTION 3F

SHOTCRETE

Index

1. REFERENCE STANDARDS. 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) with Corresponding U.S. Army Corps of Engineers Handbook for Cement and Concrete (CRD) Standard Indicated Where Available.

ASTM C 33 (CRD-C 133)	(1986) Concrete Aggregates
ASTM C 42 (CRD-C 27)	(1987) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94 (CRD-C 31)	(1989b) Ready-Mixed Concrete
ASTM C 171 (CRD-C 310)	(1969; R 1986) Sheet Materials for Curing Concrete
ASTM C 309	(1989) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 685 (CRD-C 98)	(1986) Volumetric Batching and Continuous Mixing

1.2 U.S. Army Corps of Engineers Handbook for Cement and Concrete (COE).

COE CRD-C 400	(1963) Water for Use in Mixing or Curing Concrete

2. QUALITY ASSURANCE. The Government will test shotcrete to determine compliance with this specification. The Contractor shall provide facilities and labor as may be necessary for obtaining representative test samples. Shotcrete will be sampled and tested by the method given in paragraph: TEST REPORTS.

2.1 Test Panel. One test panel will be made with minimum dimensions of 18 X 18 X 3 inches, gunned in the same positions as the work represented, for every 50 cubic yards of shotcrete placed, but at least one panel per shift. Panels shall be gunned during the course of the work by the Contractor's regular nozzleman. Panels shall be field cured in the same manner as in the job. Three 3 inch diameter cores will be drilled at least 40 hours prior to testing from each panel and tested in accordance with ASTM C 42.

3. EVALUATION AND ACCEPTANCE. The average compressive strength of three cores taken from the test panel, representing a shift or 50 cubic yards of shotcrete, tested at 28 days of age shall equal or exceed the required compressive strength specified in paragraph: SHOTCRETE QUALITY, with no individual core less than 90 percent of the required compressive strength. When the length of a core is less than twice the diameter, the correction factors given in ASTM C 42 will be applied to obtain the compressive strength of individual cores. Final acceptance of the shotcrete will be based on results obtained from cores.

4. SUBMITTALS.

4.1 Test Reports.

4.1.1 Cement and Pozzolanic Materials will be accepted on the basis of a manufacturer's certificate of compliance.

4.1.2 Aggregates will be accepted on the basis of test reports that show the material meeting the requirements of this specification.

4.2 Manufacturers Literature. Literature from suppliers which demonstrates compliance with applicable specifications for curing materials and sealant shall be supplied.

4.3 Mixture proportions and test data from prior experience if available may be submitted for approval. If test data from prior experience are not available or accepted, specimens shall be made and tested from three or more different mixture proportions in accordance with subparagraph: TEST PANEL of paragraph: PRECONSTRUCTION TESTING. The recommended mixture proportions, sources of materials, and all test results shall be submitted for acceptance. Mixture proportions shall be selected on the basis of compressive strength tests of specimens continuously moist cured until testing at 28 days. For mixture acceptance purposes, average core compressive strength shall be at least equal to 1.2 times the required compressive strength specified in paragraph: SHOTCRETE QUALITY.

4.4 Preconstruction Testing.

4.4.1 General Requirement. Test specimens shall be made by each application crew using the equipment, materials, mixture proportions and procedures proposed for the job.

4.4.2 Test Panel. A test panel at least 30 X 30 inches shall be made for each mixture being considered, and for each shooting position to be encountered in the job. The same reinforcement as in the structure shall be provided. The test panels shall be fabricated to the same thickness as the structure, but not less than 3 inches. At least five 3-inch diameter cores from each panel shall be taken for testing as per ASTM C 42.

4.4.3 Operator Qualifications. The names and qualifications of the nozzlemen shall be submitted for approval. Any additional nozzlemen added to the job throughout the project shall be similarly submitted for approval.

5. MATERIALS.

5.1 Cement shall conform to the requirements of the SECTION: CONCRETE.

5.2 Aggregates shall conform to ASTM C 33, with the combined gradation as shown below:

Sieve Size	Percent by Weight Passing Individual Sieves
19.0 mm (3/4 inch)	--
12.5 mm (1/2 inch)	--
9.5 mm (3/8 inch)	100
4.75 mm (No. 4)	95-100
2.36 mm (No. 8)	80-100
1.18 mm (No. 16)	50-85
600. um (No. 30)	25-60
300. um (No. 50)	10-30
150. um (No. 100)	2-10

5.3 Water. Fresh, clean and potable mixing water or nonpotable water which meets the requirements of COE CRD-C 400 shall be used.

5.4 Curing Materials.

5.4.1 Impervious sheet materials ASTM C 171, type optional except polyethylene film, if used, shall be white opaque.

5.4.2 Membrane - forming curing compound ASTM C 309, Type 1-D.

5.5 Shotcrete Quality. The shotcrete shall be produced by either dry-mix or wet-mix process. The required compressive strength shall be 3,500 pounds per square inch at 28 days.

6. PRODUCTION OF SHOTCRETE.

6.1 Dry Mix Process.

6.1.1 Batching and Mixing. Aggregate and cement may be batched by weight or by volume. If volumetric batching is used, a minimum of one weight batching check shall be made every 4 hours for control purposes to insure that the specified mixture design is being achieved. Weighing equipment shall be capable of batching with the accuracy specified in ASTM C 94. Volumetric equipment shall be capable of batching with the accuracy specified in ASTM C 685. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity and be capable of discharging all mixed material without any carry over from one batch to the next.

6.1.2 Delivery Equipment. The equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and delivering a continuous smooth stream of uniformly mixed material to the discharge nozzle. The discharge nozzle shall be equipped with a manually operated water injection system (water ring) for directing an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and shall be convenient to the nozzleman. The water pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to assure that the water is intimately mixed with the other materials. If the line water pressure is inadequate a water pump shall be introduced into the line. The water pressure shall

be uniformly steady (nonpulsating). The delivery equipment shall be thoroughly cleaned at the end of each shift. Equipment parts, especially the nozzle liner and water ring, shall be regularly inspected and replaced as required.

6.2 Wet Mix Process.

6.2.1 Batching and mixing shall be accomplished in accordance with the applicable provisions of ASTM C 94. If volumetric batching and mixing are used, the materials shall be batched and mixed in accordance with the applicable provisions of ASTM C 685. The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing. Ready-mix shotcrete complying with ASTM C 94 may be used.

6.2.2 Delivery Equipment. The equipment shall be capable of delivering the premixed materials accurately, uniformly, and continuously through the delivery hose. Recommendations of the equipment manufacturer shall be followed on the type and size of nozzle to be used, and on cleaning, inspection, and maintenance of the equipment.

6.3 Air Supply. Contractor shall provide a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for all parts of the work and, if required, for simultaneous operation of a suitable blow pipe for clearing away rebound.

7. PREPARATION OF SURFACES.

7.1 Earth. Earth/cemented alluvium shall be compacted and trimmed to line and graded before placing shotcrete. Surfaces to receive shotcrete shall be dampened.

7.2 Existing Concrete. All unsound and loose materials shall be removed by sandblasting, grinding, or high-pressure water jets before applying shotcrete. Any area to be repaired shall be chipped off or scarified to remove offsets which would cause an abrupt change in thickness without suitable reinforcement. Edges shall be tapered to leave no square shoulders at the perimeter of a cavity. The surface shall be dampened but without visible free water.

7.3 Shotcrete. When a layer of shotcrete is to be covered by a succeeding layer at a later time, it shall first be allowed to develop its initial set. Then all laitance, loose material, and rebound shall be removed by brooming or scraping. Laitance which has been allowed to take final set shall be removed by sandblasting and the surface thoroughly cleaned.

7.4 Rock. Rock surfaces to receive shotcrete shall be prepared as specified in the SECTION: FILLS AND SUBGRADE PREPARATION.

8. PLACEMENT OF SHOTCRETE.

8.1 General. Shotcrete shall be placed using suitable delivery equipment and procedures. The temperature of surfaces to receive shotcrete shall not be less than 35 degrees Fahrenheit.

8.2 Placement Techniques.

8.2.1 Placement Control. Thickness, method of support, air pressure, and water content of shotcrete shall be controlled to preclude sagging or sloughing off. Shotcreting shall be discontinued or suitable means shall be provided to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.

8.2.2 Corners. Horizontal and vertical corners and any area where rebound cannot escape or be blown free shall be filled first.

8.3 Placement Around Reinforcement. The nozzle shall be held at such distance and angle to place material behind reinforcement before any material is allowed to accumulate on its face. In the dry-mix process, additional water may be added to the mix when encasing reinforcement to facilitate a smooth flow of material behind the bars. Shotcrete shall not be placed through more than one layer of reinforcing steel rods or mesh in one application unless demonstrated by preconstruction tests that steel is properly encased.

8.4 Line and Thickness Control. Adequate ground wires or other accepted means shall be used to establish the thickness, surface planes, and finish lines of the shotcrete. The surfaces shall be within a tolerance of 3/8 inch as determined by a 10 foot long straightedge placed on the surfaces.

8.5 Placement Precautions. The following precautions shall be taken during placement:

a. Do not place shotcrete if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle.

b. Do not use rebound or previously expended material in the shotcrete mix.

c. The area to which shotcrete is to be applied shall be clean and free of rebound or overspray.

9. REPAIR OF SURFACE DEFECTS.

9.1 Surface Defects. Surface defects shall be repaired as soon as possible, after initial placement of the shotcrete. All shotcrete which lacks uniformity, which exhibits segregation, honeycombing, or lamination, or which contains any dry patches, slugs, voids, or sand pockets shall be removed in accordance with paragraph: EXISTING CONCRETE, and replaced with fresh shotcrete.

9.2 Core Holes. Core holes shall not be repaired with shotcrete. Instead, they shall be filled solid with patching mortar, after being cleaned and thoroughly dampened.

10. FINISHING.

10.1 Arizona Canal Lining. The Arizona Canal Lining shall receive a finished surface which shall be equivalent, in evenness, smoothness, and freedom from rock pockets and surface voids, to that obtained by effective use of a long-handled burlap trowel. The desired finish technique will be selected by the Contractor and approved by the Contracting Officer.

10.2 Natural Gun Finish. Except where noted above, the undisturbed final layer of shotcrete as applied from the nozzle without hand finishing shall be provided.

11. CURING AND PROTECTION.

11.1 Initial Curing. Immediately after finishing, shotcrete shall be kept continuously moist for at least 24 hours. One of the following materials or methods shall be used:

a. Ponding or continuous sprinkling.

b. Absorptive mat or fabric, sand, or other covering kept continuously wet.

c. Curing compounds. The application rate of 100 square feet per gallon will be used for all shotcrete. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded unless positive measures, such as sandblasting, are taken to completely remove curing compounds prior to the application of such additional materials.

11.2 Final Curing. Additional curing shall be provided immediately following the initial curing and before the shotcrete has dried. One of the following materials or methods shall be used:

a. Continue the method used in initial curing.

b. Application of impervious sheet material conforming to ASTM C 171.

11.3 Duration of Curing. Curing shall be continued for the first 7 days after shotcreting or until the required strength is obtained. During the curing period, shotcrete shall be maintained above 55 degrees Fahrenheit and in a moist condition as specified above.

12. CONSTRUCTION JOINTS. Unless otherwise specified, construction joints shall be tapered to a shallow edge form, about one inch thick. If nontapered joints are specified, special care shall be taken to avoid or remove trapped rebound at the joint. The entire joint shall be thoroughly cleaned and wetted prior to the application of additional shotcrete.

* * * * *

SECTION 3H

PRECAST PRESTRESSED CONCRETE

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 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO-01	(1983; 13th Ed; Int Specifications - Bridges 1984, 1985, 1986, 1987, 1988) Standard Specifications for Highway Bridges

1.2 American Concrete Institute (ACI) Standards.

ACI 214	(1977; R 1983) Evaluation of Strength Test Results of Concrete

1.3 American Society for Testing and Materials (ASTM) with Corresponding U.S. Army Corps of Engineers Handbook for Cement and Concrete CRD Standard Indicated Where Available.

ASTM C 31 (CRD-C 11)	(1988) Making and Curing Concrete Test Specimens in the Field
ASTM C 39 (CRD-C 14)	(1986) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 150 (CRD-C 201)	(1989) Portland Cement
ASTM C 172 (CRD-C 4)	(1982) Sampling Freshly Mixed Concrete
ASTM C 231 (CRD-C 41)	(1989a) Air Content of Freshly Mixed Concrete By The Pressure Method
ASTM C 617 (CRD-C 29)	(1987) Capping Cylindrical Concrete Specimens

1.4 Prestressed Concrete Institute (PCI) Publications.

PCI Mnl 116	(1985; 3rd Ed) Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI Mnl 120	(1985; 3rd Ed) PCI Design Handbook Precast Prestressed Concrete

2. DESIGN.

2.1 Design of Precast Prestressed Members and Connections. Design of members and connections shall be in accordance with AASHTO-01 and PCI Mnl 120.

2.2 Loads. Loadings for members and connections shall include all dead load, live load, handling, erection and other applicable loads.

2.3 Calculations. Calculations for design of members and connections not indicated on the drawings shall be made by a registered professional engineer experienced in the design of precast prestressed concrete.

3. QUALITY CONTROL.

3.1 Construction Testing by the Contractor. The Contractor shall perform testing to insure the materials and method he uses meet the requirements of these specifications and will produce precast prestressed concrete members which are suitable for their intended use. In addition, the Contractor shall perform all other testing he feels is necessary to insure the quality of the precast prestressed concrete members.

3.1.1 High Strength Steel Tendons. Testing shall be as specified in SECTION: STRESSING TENDONS AND ACCESSORIES FOR PRESTRESSED CONCRETE.

3.1.2 Concrete. Concrete shall be sampled and cylinders made in strict accordance with ASTM C 172 and ASTM C 31.

3.1.2.1 Concrete Test Cylinders. At least four test cylinders per casting bed shall be made each day the bed is used. A minimum of two test cylinders per bed shall be made to verify the strength of concrete at the time of stress transfer and a minimum of two test cylinders per day or 50 cubic yards of concrete or fraction thereof, whichever results in the most cylinders, shall be made for each mix design to verify the attainment of the specified strength. Cylinders to be used for judging stress transfer strength shall be made from concrete placed during the latter half of a casting.

3.1.2.2 Cylinder Making. Cylinders shall be made as near as possible to the location where they will be cured and shall not be disturbed in any way from one half hour after casting until they are either 20 plus or minus 4 hours old or ready to be tested. Concrete in cylinders may be consolidated by rodding or by vibration as specified in ASTM C 31. If vibrators are used, techniques shall be used which will preclude segregation.

3.1.2.3 Cylinder Curing.

3.1.2.3.1 Test cylinders shall be cured with and by the same methods as the members they represent. In lieu of actual curing with the members, cylinders may be cured in curing chambers correlated in temperature and humidity with the beds. In such a case, the correlation shall be constantly verified by use of recording thermometers in the curing chambers and comparison with the temperature records of beds, and by use of the same methods of moisture retention for curing chambers and casting beds.

3.1.2.3.2 For beds cured by steam or radiant heat, cylinders shall be placed at random points along the bed. If there is any indication of variable heat, cylinders shall be placed in the coolest area.

3.1.2.3.3 Test cylinders to indicate compliance with specified 28-day or earlier strength shall remain in the bed with the member until the member is removed. At that time the cylinders shall be removed from their molds and placed in storage in a moist condition at 73.4 degrees plus or minus 3 degrees F.

3.1.2.4 Capping of Cylinders.

3.1.2.4.1 Unless cylinder ends are cast or ground to within 0.002 inch of a plane surface, they shall be capped prior to testing. Capping procedures shall be as specified in ASTM C 31 and ASTM C 617 except with fast setting sulphur compounds, especially manufactured for capping, compression testing can be performed one half hour or less after the caps have been in place.

3.1.2.5 Testing of Cylinders.

3.1.2.5.1 Testing of cylinders to determine compressive strength shall be performed in accordance with ASTM C 39. The strength of concrete at any given age shall be determined as the average of two cylinders, except a single cylinder test can be used to determine stress transfer strength.

3.1.2.5.2 Testing machines shall be calibrated so the maximum error is not more than plus or minus one percent. Calibration shall be performed whenever there is a reason to doubt the accuracy of indicated loads, or at least once every six months. Calibration curves shall be available at all times and used by testing personnel.

3.1.3 Air Content. The air content tests shall be conducted in accordance with ASTM C 231. At least one air content test will be conducted on the concrete from which each member is cast.

4. EVALUATION AND ACCEPTANCE.

4.1 Concrete. A test result shall be the average of the strengths of the two test cylinders made in accordance with subparagraph "Concrete Test Cylinders". The strength level of the concrete will be considered satisfactory if the average of all sets of three consecutive strength tests equal or exceed the specified strength f'c and no individual test falls below the specified value by more than 500 psi. Members manufactured with concrete which does not meet the strength requirements shall be rejected.

4.1.1 Air Content. All members cast with concrete having a measured air content less than 5 percent shall be rejected. Any member cast with concrete having an air content greater than 7 percent may be incorporated into the work if the strength requirements are met.

4.2 Tolerances. The precast prestressed members shall be manufactured within the following tolerances. Members which fail to meet the dimensional tolerances shall be rejected.

4.2.1 Length of Member. The length of the member shall not deviate from the length shown on the contract drawings by more than plus or minus 3/4 inch or plus or minus 1/8 inch per 10 feet of length, whichever is greater.

4.2.2 Cross Sectional Dimensions. The cross sectional dimensions of a member, if less than 36 inches shall not vary by more than plus or minus 1/4 inch and if over 36 inches, they shall not vary by more than plus or minus 3/8 inch.

4.2.3 Horizontal Alignment (Sweep). The horizontal alignment of the members shall not deviate from a straight line parallel to the theoretical centerline by more than 1/2 inch or 1/8 inch per 10 feet of length, whichever is greater. The maximum gap between two adjacent members due to sweep shall not exceed one inch.

4.2.4 Camber. The actual camber of beams shall not deviate from the computed camber by more than plus or minus 1/8 inch per 10 feet but not more than plus or minus 1/2 inch maximum total deviation.

4.2.5 Camber Differential. The differential in camber at midspan between adjacent members shall not exceed 1/4 inch per 10 feet of length or 3/4 inch maximum.

4.2.6 Position of Tendons. The position of the tendons shall not deviate from the design position by more than plus or minus 1/4 inch.

4.2.7 Handling Devices. The actual position of handling devices shall not deviate from the designed position by more than plus or minus 6 inches.

4.2.8 Anchors and Inserts. The actual position of anchors and inserts shall not vary by more than plus or minus one inch from positions shown on the contract drawings.

4.2.9 Flange Thickness. The thickness of a flange or slab shall not vary from the dimensions on the drawings by more than plus or minus 1/4 inch or - 1/8 inch.

4.2.10 Depth of Member at Support. At the supports the depth of a member shall not deviate from the dimensions shown on the contract drawings by more than plus or minus 1/4 inch.

4.2.11 Squareness of Ends. The ends of members shall not deviate from being square by more than plus or minus 1/4 inch. Squareness shall be checked in both the vertical and horizontal planes.

4.3 Defects.

4.3.1 Minor Defects. Minor defects are those which involve less than 36 square inches of concrete, and do not expose stressing tendons or reinforcing steel. These defects will be repaired as specified hereinafter. Cracks which are visible but are 0.01 inch wide or less will be accepted.

4.3.2 Major Defects. Major defects are those which involve more than 36 square inches of concrete or expose stressing tendons or reinforcing steel. If one or more major defects appear in a member it shall be rejected. Cracks of a width of more than 0.01 inch shall be cause for rejection of the member.

5. SUBMITTALS.

5.1 Design Calculations. Design calculations shall be submitted to the Contracting Officer prior to the initiation of manufacture of members to be used under this contract.

5.2 Test Reports. Certified test reports of required material tests shall be submitted to the Contracting Officer by the Contractor prior to the use of the materials in the work. Reports shall be furnished for each shipment and shall be identified with specific lots.

5.3 Test Results. The results of construction testing by the contractor shall be submitted to the contracting officer not more than 5 days after the tests are completed.

5.4 Manufacturers' Certificate.

5.4.1 Cement. Cement shall be certified for compliance with all specifications requirements.

5.4.2 Pozzolan. Pozzolan shall be certified for compliance with all specification requirements.

5.4.3 Water-reducing admixture shall be certified for compliance with all specifications requirements.

5.4.4 Aggregates shall be certified for compliance with all specifications requirements.

5.4.5 Certified Air Content. Each precast member delivered to the job site shall be accompanied by a certificate certifying that the air content in the concrete in that member is in compliance with the specifications. The certification must be based on an air content test conducted in conformance with ASTM C 231 on at least one of the batches concrete from which the member was cast.

5.5 Concrete Mixture Proportions. Concrete mixture proportions shall be submitted to the Contracting Officer for approval.

5.6 Shop Drawings. The Contractor shall prepare and submit to the Contracting Officer for approval, complete shop drawings which show the precast unit manufacturer's recommended details and materials for the work required by paragraph: HANDLING AND ERECTION and the following:

a. Design Computations.

b. Marking of the units for the placing drawings.

c. Anchorages for work of other trades.

d. Anchorages to support construction.

e. Size and location of steel tendons.

f. Methods of stressing.

g. Location and sizes of all openings 12 inches wide or larger to be cast into members.

h. Formwork.

i. Joints between units and other construction.

j. Reinforcing steel details.

k. Method of curing.

l. Pickup points and lifting devices.

6. MATERIAL.

6.1 Cement.

6.1.1 Portland Cement shall conform to ASTM C 150 Type II or III. The C_3A content of the Type III cement shall not exceed 8 percent.

6.1.2 Blended Hydraulic Cement shall conform to the requirements of the SECTION: CONCRETE.

6.2 Pozzolan. Pozzolan shall conform to the requirements of the SECTION: CONCRETE.

6.3 Other Materials.

6.3.1 Aggregates shall meet the requirements of SECTION: CONCRETE.

6.3.2 Admixtures. In no event shall admixtures containing chlorides or nitrates be used in the concrete.

6.3.2.1 Water-Reducing Admixture shall be certified to comply with SECTION: CONCRETE.

6.3.2.2 Accelerating Admixture shall be certified to comply with SECTION: CONCRETE.

6.4 Steel Reinforcement shall be in accordance with SECTION: STEEL BARS, STEEL WELDED WIRE FABRIC, AND ACCESSORIES FOR CONCRETE REINFORCEMENT.

6.5 Steel Tendons shall be in accordance with SECTION: STRESSING TENDONS AND ACCESSORIES FOR PRESTRESSED CONCRETE.

7. COMPOSITION AND QUALITY.

7.1 Concrete shall be composed of cementitious material, water, fine and coarse aggregate and admixtures. The cementitious material shall be portland cement, blended hydraulic cement, or portland cement or blended hydraulic cement and pozzolan. The admixtures may include a water reducing admixture when its formulation and use are approved.

7.2 Quality. The concrete proportions shall be selected by the Contractor to meet the following requirements:

Specified Strength = 5000 psi at 28 days

f'c = 5000 psi at 28 days

fci = 4000 psi, prior to detensioning

Entrained Air Content = 5 to 7 percent as determined in accordance with ASTM C 231. Proportions shall be selected so as to produce an average strength exceeding the design strength f'_c by the amount indicated below. Where the production facility has a standard deviation record detenmined in accordance with ACI 214, based on 30 consecutive strength tests of similar mixture proportions to that proposed, obtained within one year of the time when concrete placing is expected, it shall be used in selecting average strength. The average strength used as the basis for selecting proportions shall exceed the specified strength f'_c by at least.

400 psi if standard deviation is less than 300 psi

550 psi if standard deviation is 300 to 400 psi

700 psi if standard deviation is 400 to 500 psi

900 psi if standard deviation is 500 to 600 psi

If the standard deviation exceeds 600 psi or if a standard deviation record is not available, proportions shall be selected to produce an average strength at least 1,200 psi greater than the specified strength. The Contractor shall have the mixture proportions determined by persons knowledgeable in the formulation of concrete mixtures. The trial mixtures shall be formulated using the same materials as those to be used in the units supplied under this specification and the selected proportions shall be submitted for approval with the results of cylinder strengths at 28 days.

8. FABRICATION. Fabrication of precast-prestressed members shall follow the applicable provisions of the PCI Mnl 116 except as specified herein.

9. BEDS AND FORMS.

9.1 All casting beds shall have concrete support on unyielding foundations.

9.2 Forms, both fixed and movable, shall be of steel of adequate thickness, braced, stiffened, anchored and aligned adequately to produce members within the limits of dimensional tolerances, specified hereafter.

9.3 Bulkheads, spacers, templates and similar equipment having influence on the accuracy of dimensions and alignment shall be regularly inspected and maintained as necessary.

9.4 Accurate alignment of forms shall be maintained during the casting operation. Form alignment and grade shall be checked for each setting. Form joints shall be smooth and tight enough to prevent leakage of paste. Joints between soffits, side forms and bulkheads may require gaskets of rubber or other suitable material to prevent leakage of paste. Such material may be used to provide corner chamfers. Plugging of holes and slots in the forms shall be done neatly so the finished member will have a workman like appearance.

9.5 For exposed members, form ties, if used, shall be of the threaded or snap-off type so no metal parts will be left at the surface of the finished concrete.

9.6 Provision shall be made in form anchorage for any anticipated differential movements of beds and forms during the casting and curing operations.

9.7 Beds and form shall be thoroughly cleaned after each use. Coatings used for release of members shall not be allowed to build up.

10. TENDONS. The tendons shall be placed, stressed and destressed in accordance with SECTION: STRESSING TENDONS AND ACCESSORIES FOR PRESTRESSED CONCRETE.

11. ANCHORAGES FOR POST-TENSIONING. Anchorages for post-tensioning tendons will not interfere with the placement of the member.

12. STEEL REINFORCEMENT. Steel bars and welded wire fabric shall be placed in accordance with SECTION: STEEL BARS, STEEL WELDED WIRE FABRIC, AND ACCESSORIES FOR CONCRETE REINFORCEMENT.

13. CONCRETE PLACEMENT. Concrete placement shall be in accordance with SECTION: CONCRETE, except that once placement is started in a member it shall be carried on in a continuous operation until the member is completed. Members shall be cast in a horizontal position and casting in tiers will not be permitted. Adequate vibration shall be provided with internal and form vibrators so the cast members shall be free of rock pockets or surface blemishes resulting from inadequate vibration. Cold joints shall not be permitted in prestressed concrete members. If delays occur which result in hardening of the concrete so it will not receive a vibrator and again become plastic, partially filled forms shall be washed out or partially cast members rejected.

14. CURING AND PROTECTION. Concrete for the manufacturing of the precast prestressed concrete members shall be cured and protected in accordance with SECTION: CONCRETE or by other methods further specified herewithin.

14.1 Curing with Steam at Atmospheric Pressure. Steam curing shall be under a suitable enclosure to retain the live steam to minimize moisture and heat losses. The enclosure shall allow free circulation of the steam around the sides and top of the beams. Steam jets shall be so positioned so they do not discharge directly on the concrete, forms, or test cylinders. The cycle of steam application shall conform to the following:

14.1.1 After placing and vibrating, the concrete shall be allowed to attain its initial set before the steam is applied. During the period between placement of the concrete and application of steam, provisions shall be made to prevent surface drying by means of a coating of membrane curing compound, moist covers or equally effective methods. Application of the steam shall be delayed not less than 2 hours and not more than 10 hours after the time of concrete placement. If the ambient temperature is below 50 degrees F. enough heat shall be applied to maintain the concrete at its placing temperature.

14.1.2 The ambient temperature within the casting enclosure shall be increased at a rate not to exceed 40 degrees F. per hour. Temperature increase shall be as uniform as possible.

14.1.3 The temperature shall be increased until the ambient temperature in the casting enclosure is between 140 degrees F. and 160 degrees F. Once this temperature range is reached, it shall be maintained until the concrete has reached the compressive strength necessary for stressing or destressing the tendons.

14.1.4 In discontinuing the steam curing the ambient air temperature shall decrease at a rate not to exceed 40 degrees F. per hour. Temperature decrease shall be as uniform as possible.

14.1.5 Recording thermometers showing the time-temperature relationship through the curing period from placing concrete to transfer of prestress shall be provided. At least one recording thenmometer per casting enclosure shall be used. The desired curing time-temperature relationship shall be placed on the recording chart of the recording thermometer, to aid the personnel that control the temperature during curing. Recording charts shall be made available upon request and shall be clearly visible during the curing process.

14.2 Curing with Radiant Heat and Moisture.

14.2.1 Radiant heat may be applied to beds by means of pipe circulating steam, hot oil or hot water or by electric blankets or heating elements on forms. Pipes, blankets or elements shall not be in contact with concrete, form surface or test cylinders.

14.2.2 During the cycle of radiant heat curing, effective means shall be provided to prevent rapid loss of moisture in any part of the member. Moisture may be applied by a covering of moist burlap or cotton matting. Moisture may be retained by covering the member with a plastic sheet in combination with an insulating cover, or by applying a liquid seal coat or membrane curing compound.

14.2.3 Temperature limits and use of recording thermometer shall be as specified for curing with steam at atmospheric pressure.

14.2.4 Termination of curing shall be as specified in SECTION: CONCRETE unless the concrete has been cured by one of the two methods stated above. Termination of curing for concrete cured by either the steam at atmospheric pressure method or the radiant heat with moisture shall be determined based on the compressive strength of the concrete necessary for stressing or destressing the tendons. The strength shall be determined from concrete cylinders as specified in paragraph entitled QUALITY ASSURANCE.

15. REPAIRS. All honeycombed areas, chipped corners, air pockets over 1/4 inch in diameter, and other minor defects shall be repaired. Form offsets of fins over 1/8 inch shall be ground smooth. All unsound concrete shall be removed from defective areas prior to repairing. All surfaces permanently exposed to view shall be repaired by a blend of portland cement and white cement properly proportioned so that the final color when cured will be the same as adjacent concrete.

16. FINISHING.

16.1 Unformed surfaces shall receive a rough finish.

17. HANDLING AND ERECTION.

17.1 General. The location of pickup points for handling of the members and details of the pickup devices shall be shown on shop drawings. Members shall be handled only by means of approved devices at designated location.

17.2 Position of Members. In the handling of members, it is imperative they be maintained in an upright position at all times and picked up and supported as shown on approved shop drawings.

17.3 Storage.

17.3.1 Storage areas for prestressed members shall be stablized, and suitable foundations shall be provided, so differential settlement or twisting of members will not occur.

17.3.2 Stacked members shall be separated and supported by battens placed across the full width of each bearing point. Battens shall be arranged in vertical planes at a distance not greater than the depth of the member from designated pickup points. Battens shall not be continuous over more than one stack of precast units. Stacking of members shall be such that lifting devices will be accessible and undamaged. The upper members of a stacked tier shall not be used as storage areas for shorter members or equipment.

17.4 Transportation.

17.4.1 In transporting members by truck, railroad car or barge, provision shall be made for suporting the members as described above, except battens can be continuous over more than one stack of units, with adequate bracing to insure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are generally satisfactory provided the members are fully seated on the outer bolsters at not more than 3 feet or the depth of the member from the end and the inner bolster is not more than 8 feet from the end of the member or the designated pickup point. Adequate padding material shall be provided between tie chains or cables to preclude chipping of concrete.

17.4.2 Any noticeable indication of lateral deflection or vibration during transportation shall be corrected by rigid bracing between members or by means of lateral trussing.

17.5 Erection.

17.5.1 All provision for storage and handling given in the foregoing paragraph shall be observed at the erection site.

17.5.2 The precast prestressed concrete members shall be set into place in a manner which assures full bearing. If the bearing called for on the contract drawing is not obtained then the members shall be removed and the situation corrected.

17.5.3 Welding during erection shall be done in accordance with SECTION: MISCELLANEOUS METALS. When welding or burning with a welding electrode, the ground shall be attached directly to the base metal. Under no circumstances shall the member be used as a conductor for the ground.

17.5.4 The Contractor shall prepare a detailed erection plan which will be submitted to the Contracting Officer at least 15 days prior to the date that erection of members is to begin. This plan shall be in sufficient detail so that adequacy of equipment, techniques and accessories can be determined and comments offered. Acceptance of the contractor's erection plan shall not relieve the contractor of his responsibility for erecting precast prestressed members into position as required by the plans and specifications.

18. QUALITY CONTROL.

18.1 General. The Contractor shall establish and maintain quality control to assure compliance with contract requirements and shall maintain records of his quality control for all construction operations required under this section.

18.2 Records. Complete records shall be kept of the manufacturing, handling and erection of the precast prestressed concrete members. Records shall be kept for but not limited to the following items:

18.2.1 Specifications of material used in the manufacture of the members.

18.2.2 Time-temperature history of the concrete members from casting to the transfer of the prestress force.

18.2.3 Records of the tendon stressing operation including initial prestress force, measured elongation, how it was measured and how the tendons were stressed and destressed.

18.2.4 Records of inspection of the members before and after the prestress force is transferred to the members.

18.2.5 Records of the inspection of the members each time they are moved.

18.2.6 Records of any defects in the member and any corrective measures taken.

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SECTION 4A

REINFORCED MASONRY

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 U.S. Army Corps of Engineers Handbook for Cement and Concrete (CRD) Publication.

CRD-C 619	(1985) Grout Fluidifier for Preplaced Aggregate Concrete

1.2 American Concrete Institute (ACI) Standard.

ACI SP-66	(1988) ACI Detailing Manual

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

ASTM A 82	(1982) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 116	(1988) Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 615	(1987a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 5	(1979; R 1988) Quicklime for Structural Purposes
ASTM C 33	(1986) Concrete Aggregates
ASTM C 39	(1986) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 90	(1985) Hollow Load-Bearing Concrete Masonry Units
ASTM C 91	(1989) Masonry Cement
ASTM C 140	(1975; R 1988) Sampling and Testing Concrete Masonry Units
ASTM C 144	(1987) Aggregate for Masonry Mortar
ASTM C 150	(1989) Portland Cement

ASTM C 207	(1979; R 1988) Hydrated Lime for Masonry Purposes
ASTM C 270	(1989) Mortar for Unit Masonry
ASTM C 404	(1987) Aggregates for Masonry Grout
ASTM C 426	(1970; R 1988) Drying Shrinkage of Concrete Block
ASTM C 641	(1982; R 1986) 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 [and field] 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. SAMPLE PANELS. After material samples are approved, and prior to starting masonry work, construct sample panels of each type and color of masonry. Sample panels shall not be built in or as part of the structure but shall be located where directed. Panels shall be not less than 6 feet long by 4 feet high, except that panels may be 4 feet long by 2 feet high. Panels shall be of typical wall thickness for the masonry represented. Panels shall show color range, texture, bond, mortar joints including tooling, anchors, joint reinforcement, wall ties, reinforcing bars, grouting, and cleaning of masonry. The approved sample panels after cleaning shall be used as a standard of workmanship for the type of masonry represented. Protect sample panels from the weather and construction operations until the masonry work controlled by the sample panels has been completed and approved. Remove sample panels after completion of work controlled by the panel. Erection of masonry will not be permitted until sample panels have been approved.

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.

d. Aggregates - One sample shall be taken at the source from each stockpile for each type aggregate specified herein. Each sample shall be collected by taking three incremental samples at random from the source material to make a composite sample of not less than 10 pounds.

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. Lime

d. 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 dry 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.

4.4.1 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; and wall openings. 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. Masonry erected when the ambient air temperature is more than 99 degrees F. in the shade and the relative humidity is less than 50 percent shall be protected from direct exposure to wind and sun for 48 hours after installation.

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. The air temperature on both sides of the masonry shall

be maintained above 40 degrees F. for at least 72 hours, but time may be reduced to 48 hours if high-early-strength cement is used instead of portland cement or masonry cement in the mortar. 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 1/1/4 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 ASTM C 144.

7.4.2 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.

7.4.3 Lightweight Aggregate. ASTM C 331 except gradation shall conform to ASTM C 33 or ASTM C 404 as indicated in Grading Table.

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 1.

7.5.1.1 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.

7.5.1.2 Wire anchors for use with embedded slots or wire inserts shall be formed from not lighter than 9 gage wire looped and closed.

7.6. Portland Cement. ASTM C 150, Type II, including the requirements for low alkali content.

7.7 Concrete Masonry Units. Type and color to as indicated on the drawings.

7.7.1 Aggregates. ASTM C 33 or ASTM 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 0.045 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, lintel, and bond beam units and special shapes and sizes to complete the work as indicated.

7.7.3.1 Hollow Concrete Masonry Units. ASTM C 90, Type I, grade N-I.

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.

7.9 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.

Type	Minimum Wire Size Longitudinal Wire	Minimum Wire Size Crosswires
Standard Duty	9 gage	9 gage

7.9.1 Finish. Joint reinforcement for walls shall be formed from wire that has been zinc coated in accordance with ASTM A 116, Class 1.

7.9.2 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.

7.9.3 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.

7.9.4 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.

7.10 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.

7.10.1 Hydrated Lime. ASTM C 207, Type S.

7.10.2 Pulverized Quicklime. ASTM C 5, except 100 percent shall pass the No. 20 sieve and 90 percent shall pass the No. 50 sieve.

7.11 Reinforcing Bars. ASTM A 615, Grade 60.

7.12 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 property specifications of ASTM C 270 as modified below. Materials shall be Portland or masonry cement, hydrated lime or lime paste, aggregate, mortar coloring and water as specified herein. Mortar used for concrete masonry construction shall match the color of the masonry units. 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.

8.2 Color. Mortar Coloring, not to exceed 3 percent of the weight of cement for carbon black and 10 percent of the weight of cement for all other pigments, shall be added to the mortar used for exposed masonry surfaces to produce a uniform color matching concrete masonry unit. The color pigment should be ground into the cement at the cement mill or shall be furnished in accurately pre-measured and packaged units that can be added without measuring to a measured amount of cement.

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 I.

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 I.

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. PROTECTION. Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in process. Covering shall extend a minimum of 2 feet down on each side of the wall and be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

12. INSTALLATION.

12.1 Laying Masonry Units. 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.

12.1.1 Tolerances. Lay masonry plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Lay masonry within the following tolerances.

12.1.1.1 Variation from the plumb in the lines and surfaces of columns, walls and arrises.

a. In adjacent masonry units - 1/8 inch.

b. In 10 feet - 1/4 inch.

c. In any story or 20 feet maximum - 3/8 inch.

d. In 40 feet or more - 1/2 inch.

12.1.1.2 Variations from the plumb for external corners, expansion joints, and other conspicuous lines.

12.1.1.3 Variations from the level or grades indicated on the drawings for exposed parapets, horizontal grooves, and other conspicuous lines.

a. 20 feet maximum - 1/4 inch.

12.1.1.4 Variations of the linear lines from established position in plan and related portion of walls.

a. In any or 20 feet maximum - 1/2 inch.

b. In 40 feet or more - 3/4 inch.

12.1.2 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.

12.1.3 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.

12.1.4 Unfinished Work. Step back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

12.1.5 Wetting Masonry Units. Do not wet concrete masonry units. Do not lay units having a film of water or frost on the surface.

12.1.6 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.

12.1.6.1 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.

12.1.6.2 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.

12.1.7 Joint Widths. Joint widths shall be approximately 3/8 inch wide.

12.1.8 Forms and Shores. Where required, construct forms to the shapes, lines, and dimensions of the members indicated. Construct forms sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected. In no case shall supporting forms or shores be removed in less than 10 days. At least 16 hours shall have elapsed after grouting masonry columns or walls before applying uniform loads and an additional 48 hours shall have elapsed before applying concentrated loads.

12.2 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 all cells filled solidly with grout. 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.

12.2.1 Bond Pattern. Except where stacked bond is indicated, lay hollow masonry units in running bond.

12.2.3 Mortar Joints. Fill bed joints with mortar for the full thickness of the face shell. 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.

12.2.3 Joint Reinforcement. Place joint reinforcement so that longitudinal wires are fully embedded in the face shell mortar bed for their entire length. Provide a minimum mortar cover over longitudinal wires of 5/8 inch on the weather side of walls and 1/2 inch at all other locations. Lap reinforcement at least 6 inches for deformed longitudinal wires and at least 12 inches for smooth longitudinal wires. Install factory-fabricated sections at corners and wall intersections.

12.3 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.

12.3.1 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.

12.3.2 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. Welded or mechanical connections shall develop at least 125 percent of the strength of the reinforcement.

12.4 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 I.

12.4.1 Grout Holes. Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars. Provide additional openings spaced not more than 16 inches on centers where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug grouting holes and finish to match surrounding surfaces.

12.4.2 Grouting Equipment.

12.4.2.1 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.

12.4.2.2 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.

12.4.3 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 one 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.

12.4.4 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, tear down and re-build the wall at no additional cost to the Government.

12.5 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.

12.5.1 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.

12.6 Field Tests.

12.6.1 Moisture Content. Sampling and testing of concrete masonry units for moisture content shall be performed by the Contractor. Upon delivery of units to the project site and periodically thereafter, samples shall be selected at random from stockpiles and tested in accordance with ASTM C 140. If the moisture content requirements in ASTM C 90 are not met additional protection for stockpiles will be provided immediately. If the moisture content is over 5 percent the maximum, the units will be rejected for use until they are made to conform to the moisture content requirements.

TABLE I

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS

GROUT SPACE DIMENSIONS

Minimum Horizontal Dimensions of Core (inches)	Grout Type (See paragraph Grout)	Coarse Aggregate	Maximum Height of Grout Pour (inches)
2 by 3	Fine	None	8
2 by 4	Fine	None	16
2-1/2 by 4	Fine or low lift	ASTM C 404, Size 8	48

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SECTION 5A

MISCELLANEOUS METALS

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 American National Standards Institute (ANSI).

ANSI A14.3	(1984) Safety Requirements for Fixed Ladders
ANSI B16.3	(1985) Malleable Iron Threaded Fittings
ANSI B18.2.1	(1981) Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	(1987) Square and Hex Nuts (Inch Series)

1.2 American Society for Testing and Materials (ASTM).

ASTM A 36	(1988c) Structural Steel
ASTM A 48	(1983) Gray Iron Castings
ASTM A 120	(1984) Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
ASTM A 123	(1984) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 126	(1984) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 307	(1988a) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 320	(1988) Alloy Steel Bolting Materials for Low-Temperature Service
ASTM A 500	(1984) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 513	(1988) Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM B 26	(1988) Aluminum-Alloy Sand Castings

ASTM B 32	(1989) Solder Metal

1.3 American Welding Society (AWS).

AWS D1.1	(1988) Structural Welding Code - Steel

1.4 Federal Specifications (FS).

FS FF-S-325	(Basic) Shield, Expansion, Nail, Expansion and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS QQ-B-750	(Rev A; Am 2) Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections
FS RR-C-271	(Rev C) Chains and Attachments, Welded and Weldless
FS TT-E-489	(Rev H) Enamel, Alkyd, Gloss Low Voc Content
FS VV-G-632	(Rev A; Am 1) Grease, Industrial, General Purpose

1.5 Military Specifications (MS).

MS MIL-F-3541	(Rev B; Am 2) Fittings, Lubrication

1.6 National Association of Architectural Metal Manufacturers (NAAMM).

NAAMM MBG 531	(1988) Metal Bar Grating Manual

2. GENERAL.

2.1 Shop Drawings. Complete shop drawings for fabrication of fence panels, fence posts, pipe gates, and outlet gates shall be submitted for approval in accordance with the requirements of the SPECIAL CLAUSES.

2.2 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.

2.3 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.

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 120, Standard Weight, Schedule 40.

3.3 Steel Shapes and Plates.

3.3.1 Steel bars, angles, 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 500, Grade A for posts, and ASTM A 513 for pickets and rails.

3.4 Concrete, mortar and grout shall conform to the requirements of SECTION: CONCRETE.

3.5 Formwork shall conform to SECTION: FORMWORK FOR CONCRETE.

3.6 Chain shall be galvanized and shall conform to the requirements of FS RR-C-271, Type 1, 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, nuts, and washers shall be of the material, grade, type, class, style and finish indicated or best suited for intended use.

3.7.1 Bolts and nuts shall be ASTM A 307, Grade A, hot-dip galvanized or ASTM A 320.

3.7.2 Bolts shall be ANSI B18.2.1.

3.7.3 Nuts shall be ANSI B18.2.2.

3.7.4 Plain washers shall be ANSI B18.22.1, Type B.

3.8 Expansion bolts shall be galvanized and shall conform to FS FF-S-325.

3.9 Grease fittings shall conform to MS MIL-F-3541.

3.10 Signs. Reflective material on picket fence gate, pipe gate and pipe barrier reflectors and Unauthorized Vehicles Prohibited signs on pipe gates shall conform to the State Specifications of the Department of Transportation, Highway Division of the State of Arizona. Unauthorized Vehicles Prohibited signs on pipe gates shall be constructed as indicated on the drawings. Letters are to be black reflective material, standard 2 inch. Sign background shall be silver white. The reflectors and signs shall be constructed of heavy galvanized bonderized steel sheets having a minimum thickness of 16 gauge. Sign markings shall be baked enamel.

3.11 Pipe caps shall conform to ANSI B16.3.

3.12 Bronze shall conform to FS QQ-B-750, hard temper of either composition.

3.13 Cast Iron for Flap Gates shall conform to ASTM A 126, Class B.

4. FABRICATION.

4.1 Picket Fence Panels. Pickets shall be steel tubing with caps welded at the top of the pickets. Fence 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. Pickets, rails, and brackets shall be shop painted with 1 coat of zinc chromate primer and 2 coats of flat black exterior oil paint conforming to FS TT-E-489, Class A. 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. The dry film thickness of the 3-coat application shall not be less than 4.0 mils with the primer having a minimum dry thickness of 1.5 mils.

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 rejecting 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 Pipe Gate. Pipe gates shall be fabricated with steel pipe and shall be fabricated in the shop. Care shall be taken to deform pipe without "breaking" the steel. Any pipe deformations that demonstrate visible cracking or weakening may be cause for rejecting the pipe gate or shall be repaired at no additional cost to the Government. All metal gate components (except grease fittings) shall be galvanized. Welded, cut, damaged, and deformed areas of galvanizing metal shall be neatly coated with Grade 50B solder conforming to ASTM B 32. A minimum of two bolts, each not less than 1/4 inch in diameter, shall be used to fasten panels and signs to the pipe gates.

4.4 Gratings and Frames. Steel grating shall be manufactured in accordance with the NAAMM MBG 531 for bar-type gratings. Edges shall be banded with bars 1/4 inch less in height than bearing bars for grating sizes above 3/4 inch. Banding bars shall be flush with the top of bearing bars. Frames shall be of welded steel construction finished to match the grating. Gratings and frames shall be galvanized after fabrication.

4.5 Ladders. Ladders shall be steel fixed-rail conforming to ANSI A14.3. Ladders and accessories shall be galvanized. Rungs shall be solid-section rods, fitted into punch holes in rails, welded and ground smooth. All splices and connections shall have a smooth transition with original members without projections that are sharp or more extensive than that required for joint strength. Rails shall be fitted with brackets at the spacing indicated for anchorage to structure. Ladders taller than 20 feet shall be equipped with a safety device.

4.6 Steps and Eye Bolts. Steps for the inlet structure shall be of A36 steel and as detailed on the drawings. Eyebolts shall be as shown on the drawings.

4.7 Side Drain Flap Gates. Flap Gates shall be required for the side drains indicated and shall have a clear opening of the same diameter as the side drain pipe. Flap gates shall be designed and constructed to prevent backflow, withstand a seating head of 10 feet and shall be free flowing for unseating heads. Seat and cover shall be cast iron. Links shall be galvanized steel with commercial grade bronze bushings at pivot points. The flap gates shall be installed in accordance with the installation instructions recommended by the manufacturer.

4.8 Sediment Range Markers. The bronze sediment range markers will be provided as Government-furnished material. The Contractor shall install the markers as shown on the drawings by angering a hole, filling it with concrete, and then attaching the marker. The locations of the markers are shown on the drawings.

4.9 Watertight Manhole Frame and Cover. Watertight manhole frames and covers shall conform to the dimensions and details as shown on the drawings. Manhole covers shall have the name of agency and/or utility imprinted for which manhole is needed as shown on the drawings and as directed by the Contracting Officer. Frames and covers shall be cast gray iron conforming to ASTM A 48, Class 30. The frames and covers shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Before the castings are removed from the foundry, they shall be cleaned and the parting lines ground flush. The bearing surfaces of frames and covers shall be machined and the cover shall seat firmly onto the frame without racking.

4.10 Aluminum Manhole Frame and Cover. Watertight manhole frames and covers shall conform to the dimensions and details as shown on the drawings. Manhole covers shall have the name of agency and/or utility imprinted for which manhole is needed as shown on the drawings and as directed by the Contracting Officer. Frames and covers shall be cast aluminum conforming to ASTM B 26, Alloy 356.0T6. The frames and covers shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Before the castings are removed from the foundry, they shall be cleaned and the parting lines ground flush. The bearing surfaces of frames and covers shall be machined and the cover shall seat firmly onto the frame without racking.

5. INSTALLATION.

5.1 General. Fence posts, both concrete and steel, and pipe gate posts 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.

5.2 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.

5.3 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 to 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.

5.4 The Contractor shall use non-shrink grout conforming to the requirements of SECTION: CONCRETE to fill the voids under and above the base plates for fence posts.

5.5 The Contractor shall grease pipe gate fittings thoroughly with grease conforming to FS VV-G-632 immediately after installation of gate leaves. The gates shall be installed in such a fashion that they work freely. The Contractor shall examine the

operation of all pipe 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, and requirements for repair shall conform to the requirement for installation above.

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SECTION 9B

STATION MARKING

1. APPLICABLE PUBLICATIONS. The Federal Specification (FS) 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.

FS TT-P-115	(Rev F) Paint, Traffic, Highway, White and Yellow

2. MATERIALS. Exterior Paint on Concrete shall conform to Fed. Spec. TT-P-115, except the color shall be non-fading black.

3. PREPARATION OF SURFACES. Concrete surfaces shall be thoroughly cleaned of all curing compound, efflorescence, dirt, oil or other deleterious material by approved methods. The surface preparation shall be accomplished in such manner that paint will satisfactorily adhere to the surface.

4. APPLICATION. Painting shall be performed in a neat and workmanlike manner and may be applied by brush, spray, roller or any combination of these methods. Painting of numbers and letters shall be accomplished with stencils and brush and spray application. Color for letters and numbers shall be black. All markings on concrete shall be in uniform capital block letters and numbers, 6 inches high, 3 inches wide, and 3/4-inch wide of line. Markings on concrete walls shall be horizontal with the bottom of the marking 5 feet above the bottom (invert at walls) of the wall.

5. TABULATION OF STATION MARKING LOCATIONS.

WALL	STATION	TEXT OF MARKING
Left	780+00	78
Left	790+00	79
Left	800+00	80
Left	810+00	81
Left	820+00	82
Left	830+00	83
Left	840+00	84
Left	850+00	85
Left	860+00	86
Left	870+00	87
Left	880+00	88
Left	890+00	89
Left	900+00	90
Left	910+00	91
Left	920+00	92
Left	930+00	93
Left	940+00	94
Left	950+00	95
Left	960+00	96
Left	970+00	97
Left	980+00	98
Left	990+00	99
Left	1000+00	100

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SECTION 11A

MISCELLANEOUS ITEMS OF WORK

1. 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 SECTION: SPECIAL CLAUSES. Submittals shall be complete; shall indicate type, style, and dimensions; and shall show construction details, anchorage, and installation.

2. DRINKING FOUNTAINS. Drinking fountain assembly shall include the complete installation of the following:

Drinking Fountain and Pedestal
Dry Well

2.1 Drinking Fountain and Pedestal. Drinking fountain and pedestal shall be a product of a manufacturer regularly engaged in the manufacture of precast, exterior, free-standing water fountains. They shall be finished, sized, and installed at the locations indicated on the drawings. Fountain shall contain integral satin chrome-plated anti-squirt bubbler mounted on a stainless steel receptor. Unit shall be equipped with pushbutton valve with automatic stream regulator and secured with vandal-resistant screws. Units shall be plumbed and mounted in accordance with manufacturer's written instructions.

2.4 Dry Well, Gravel, and Piping. Dry well shall be a gravel filled sump well of the size and location indicated on the drawings. Gravel shall be as specified in SECTION: MISCELLANEOUS AGGREGATES. Piping shall conform to the applicable requirements of the SECTION: WATER LINES.

3. TRASH RECEPTACLES. Trash receptacles shall be installed in locations as indicated on the drawings complete with concrete base. Trash receptacles shall be 32 gallon, reinforced concrete, with exposed aggregate finish, and shall be a product of a manufacturer regularly engaged in the manufacture of precast, exterior, free-standing trash receptacles. Color shall be brown, and shall weigh not less than 800 pounds.

4. BIKE RACKS. Bike racks shall be a product of a manufacturer regularly engaged in the manufacture of bike racks of the type indicated and shall be installed at locations as indicated on the drawings.

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SECTION 16A

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

Index

PART 1 GENERAL

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

1.1 American Association of State Highway and Transportation Officials (AASHTO).

AASHTO-01	(1983; 13th Ed; Int Specifications - Bridges 1984, 1985, 1986, 1987, 1988) Standard Specifications for Highway Bridges
AASHTO-02	(1985; Rev 1986, 1987) Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

1.2 American National Standards Institute, Inc. (ANSI).

ANSI C2	(1990) National Electrical Safety Code
ANSI C78.380	(1984) Method for the Designation of High-Intensity Discharge Lamps
ANSI C80.1	(1983) Rigid Steel Conduit - Zinc Coated
ANSI C82.4	(1985; C82.4a-1988) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple Supply Type)
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C136.2	(1985) Voltage Classification of Luminaires Used in Roadway Lighting Equipment
ANSI C136.3	(1989) Luminaire Attachments Used in Roadway Lighting Equipment

ANSI C136.6	(1984) Mechanical & Optical Interchangeability of Metal Heads and Reflector Assemblies Used in Roadway Lighting Equipment
ANSI C136.9	(1984) Mechanical Interchangeability of Socket Support Assemblies for Use in Metal Heads Used in Roadway Lighting Equipment
ANSI C136.10	(1988) Physical and Electrical Interchangeability of Photocontrol Devices, Plugs, and Mating Receptacles Used in Roadway Lighting Equipment
ANSI C136.11	(1988) Multiple Sockets Used in Roadway Lighting Equipment
ANSI C136.14	(1988) Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity Discharge Lamps
ANSI C136.15	(1986) High-Intensity Discharge and Low-Pressure Sodium Lamps in Luminaires-Field Identification
ANSI Z35.1	(1972) Accident Prevention Signs

1.3 American Society for Testing and Materials (ASTM).

ASTM A 123	(1984) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 8	(1986) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1985) Salt Spray (Fog) Testing
ASTM D 1654	(1979a; R 1984) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

1.4 Factory Mutual Engineering and Research Corp (FM).

FM-01	(1989; Suppl I & II) Approval Guide: A Guide to Equipment, Materials and Service Approved by Factory Mutual Research for Property Conservation

1.5 Federal Specifications (FS).

FS W-F-1814/GEN	(Rev A; Suppl 1, Notice 1) Fuses, Cartridge, High-Interrupting Capacity

FS W-S-610	(Rev D; Notice 1) Splice Connectors
FS FF-P-101	(Rev F) Padlocks

1.6 Illuminating Engineering Society of North America (IES).

IES RP-8	(1983) Roadway Lighting

1.7 Institute of Electrical and Electronics Engineers, Inc (IEEE).

IEEE Std 142	(1982) Recommended Practice for Grounding of Industrial and Commercial Power Systems

1.8 Military Specifications (MS).

MS DOD-P-21035	(Rev A) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

1.9 National Electrical Manufacturers Association (NEMA).

NEMA AB 1	(1986; Rev 1) Molded Case Circuit Breakers and Molded Case Switches
NEMA FB 1	(1988) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA PB 1	(1984) Panelboards
NEMA PB 2	(1984; PB 2.1-1986) Deadfront Distribution Switchboards
NEMA SG 3	(1981) Low-Voltage Power Circuit Breakers
NEMA TC 6	(1983) PVC and ABS Plastic Utilities Duct for Underground Installation

1.10 National Fire Protection Association (NFPA).

NFPA 70	(1990) National Electrical Code

1.11 Underwriters Laboratories Inc. (UL).

UL-03	(1989; Suppl) Electrical Construction Materials Directory
UL 6	(Oct 23, 1981, 9th Ed.; Rev Nov 22, 1989) Rigid Metal Conduit
UL 198E	(Jul 12, 1988, 4th Ed.; Rev Jul 13, 1988) Class R Fuses
UL 467	(Nov 22, 1984, 6th Ed.; Rev thru Nov 14, 1986) Grounding and Bonding Equipment

UL 486A	(Nov 24, 1980, 7th Ed.; Rev thru Oct 12, 1989) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(Apr 13, 1982, 2nd Ed.; Rev thru Oct 12, 1989) Wire Connectors for Use with Aluminum Conductors
UL 489	(Sep 15, 1986, 7th Ed.; Rev thru Apr 13, 1989) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 514A	(Dec 1, 1983, 7th Ed.; Rev thru Jan 22, 1990; Errata Feb 15, 1990) Metallic Outlet Boxes
UL 854	(Feb 9, 1987, 7th Ed.; Rev thru Feb 2, 1990) Service-Entrance Cables
UL 1242	(Oct 10, 1983, 1st Ed.; Rev Nov 23, 1989) Intermediate Metal Conduit
UL 1571	(Feb 7, 1984; 2nd Ed; Rev thru Jul 7, 1989) Incandescent Lighting Fixtures
UL 1572	(Dec 10, 1984, 2nd Ed.; Rev thru Mar 31, 1989) High Intensity Discharge Lighting Fixtures

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 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 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 ASTM A 153.

2.4.3 Luminaires. 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. 1,500 Feet.

2.5.2 Ambient Temperature. 90°F.

2.5.3 Wind Velocity. 100 mph.

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. The following shall be submitted in accordance with SECTION: SPECIAL CLAUSES:

3.1 Manufacturer's Catalog Data. The Contractor shall submit the following types of data to supplement the manufacturer's data and drawings, and Contractor's drawings.

3.1.1 Certifications shall be submitted when specified or required, including Certified Factory and Field Test Reports, and Certificates of Compliance submitted in lieu of other proofs of compliance with these contract provisions.

3.2 Detail Drawings. After receiving complete material lists, but before installing any of these items, the Contractor shall submit complete detail drawings and such other descriptive data as the Contracting Officer may require to demonstrate compliance with the contract documents. Detail drawings shall show the ratings of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and detail drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings and manufacturers' data shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Catalog cuts and published materials amy be included to supplement drawings. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually furnished for this project. External wiring connections shall be clearly identified.

Detail drawings shall be submitted for the following items and such other items as the Contracting Officer may direct:

a. Service Entrance Section (Meter Pedestal).
b. Secondary panel boards.
c. Lighting luminaires, mounting brackets, poles, and pole bases.
d. Handholes and pullboxes.
e. Cable.

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.

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.

3.3 Material, Equipment, and Fixture Lists. 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 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.

3.4.1 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.

3.5 Certificates 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 FS, 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 UL-03 or listing in FM-01 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.

3.5.1 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.

3.6 Operation and Maintenance 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.

PART 2 PRODUCTS

4. MATERIALS. Materials shall conform to the following requirements:

4.1 Cables. Cables shall be of annealed copper, except 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. 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 Connectors. FS W-S-610; UL 486A for copper conductors and UL 486B for aluminum conductors; and ANSI C119.1 for sealed insulated connectors.

4.3 Concrete. Concrete shall be a minimum of 3,000 psi at 28 days, as specified in SECTION: CONCRETE.

4.4 Conduit and Fittings, Steel.

4.4.1 Conduit, Intermediate Metal. UL 1242.

4.4.2 Conduit, Rigid. ANSI C80.1 and UL 6.

4.4.3 Conduit Outlets and Fittings. NEMA FB 1, and UL 514A.

4.5 Duct and Conduit Calking Compound. Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F., shall neither slump at a temperature of 300 degrees F., nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of 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.

4.6 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.

4.6.1 Plastic. NEMA TC 6 Thickwall: Type DB. 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.

5. COMPONENTS.

5.1 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.

5.2 Lamps and Ballasts, High-Intensity-Discharge Type. Lamps shall be suitable for the burning position utilized. 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.

5.2.1 High-Pressure Sodium Lamps. ANSI C78.380, installed where indicated.

5.3 Luminaire Components, Roadway Lighting.

5.3.1 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.

5.3.2 Photo-Control Devices. ANSI C136.10.

5.4 Luminaries, Floodlighting. UL 1571 and UL 1572.

5.5 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.

5.6 Padlocks. Padlocks shall conform to FS FF-P-101, size 3-1/2 minimum.

5.7 Poles. Poles shall be steel.

5.8 Protective Apparatus and Metering Devices.

5.8.1 Circuit Breakers, Low-Voltage. Power, NEMA SG 3 molded-case, NEMA AB 1 and UL 489.

5.8.2 Fuses, Low-Voltage, Current-Limiting. FS W-F-1814/GEN, Class L or UL 198E, Class R.

5.8.3 Watthour Meters. All meters will be furnished and installed by the utility company. The Contractor shall provide meter sockets to meet Arizona Public Service requirements.

5.8.4 Panelboards. NEMA PB 1. All panelboards shall be equipped with padlock attachments.

5.8.5 Switchboard, Dead-Front Distribution Type. NEMA PB 2.

5.8.6 Control Cabinets. NEMA 3R construction and equipped with padlock attachments.

5.9 Service Entrance Equipment. UL listed and approved for use by the Arizona Public Service. Outdoor equipment shall be installed in NEMA 3R enclosure.

5.10 Warning Signs, High-Voltage. ANSI Z35.1, porcelain enameled steel or approved equal.

6. FACTORY COATING. Equipment and component items, including but not limited to transformer stations and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finsihed, 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 MS DOD-P-21035.

PART 3 EXECUTION

7. GENERAL INSTALLATION REQUIREMENTS. Steel conduits installed underground shall be installed and protected from corrosion. Except as specified 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.

8. 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, each handhole, each pullbox, 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 for fireproofing application methods, and shall be approved before any work is done. 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.

8.1 Duct Line Installation. Cables shall be installed in duct lines. Cable splices in low-voltage cables shall be made in handholes only. Neutral and ground conductors shall be installed in the same duct with their associated phase conductors.

9. 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.

10. DUCT LINES. Duct lines shall be nonencased direct-burial, thick-wall type. Communication lines run elsewhere may be direct-burial, thick-wall type.

10.1 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 handhole, a pullbox, or between 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. 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.

10.2 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.

10.3 Nonencased Direct-Burial. Top of duct lines shall be not less than 24 inches below finished grade. Ducts shall be installed with a minimum of 3 inches of sand or stone-free earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of sand or stone-free earth is required. Bottoms of trenches shall be graded toward 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 alinement with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alinement prior to backfilling. Selected earth at duct banks shall be thoroughly tamped in 4- to 6-inch layers.

10.4 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.

10.4.1 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.

10.5 Ground Rods. In each handhole, at a convenient point close to the wall, a 3/4 inch by 8-foot copper-clad steel ground rod shall be driven into the earth. When precast concrete handholes are used, the top of the ground rod may be below the floor and a No. 8 AWG tinned ground conductor brought into the handhole through a watertight sleeve in the handhole wall. This ground rod shall be utilized to ground fixture poles as indicated.

11. TRANSFORMER STATIONS. Transformer stations will be provided by the utility company.

11.1 Concrete Pads. Concrete pads shall be constructed as indicated. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Conduits for primary, secondary, and grounding conductors shall be set in place prior to pouring of concrete pads.

11.2 Padlocks shall be provided for all electrical panels.

12. LIGHTING.

12.1 Roadway Lighting Luminaires. 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.

12.2 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.

12.3 Photo-Control. Where indicated, luminaires shall be individually controlled by a photo-control element mounted on the luminaire. Each photo-control element shall have an adjustable operating range of approximately 0.5 to 5.0 footcandles and shall be mounted in a replaceable, weatherproof, plug-in or twist-lock assembly.

12.4 Poles. Lighting poles shall be a nominal 20 feet in length of steel, as indicated. 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-02. 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.

12.4.1 Steel poles and steel brackets shall be hot-dip galvanized in accordance with ASTM A 123 and shall not be painted.

12.4.2 Poles shall be mounted on cast-in-place foundations. Conduit ells shall be provided for cable entrances into pole interiors. 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.

13. CONCRETE HANDHOLES AND PULLBOXES. Concrete handholes and 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. Handhole and pullbox tops shall be flush with sidewalks or curbs or placed 1/2-inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked Low-Voltage and provided with 2 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. In paved areas, frames and covers for handhole entrances in vehicular traffic areas shall be rated for H20 wheel loads in accordance with AASHTO-01 and top of covers shall be flush with the finished surface of the paving.

14. METER PEDESTALS. 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. Panelboards shall be circuit breaker equipped, Type I. Circuit breaker interrupting capacities shall conform to UL 489 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.

14.1 Installation. Meter pedestals shall be mounted on a concrete base, reinforced as indicted. The top of the concrete base shall be approximately 3 inches above the finished grade. The base shall be of adequate size to project beyond the equipment and sloped to drain. Concrete shall be 3,000 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.

15. GROUNDING. Neutral conductors, metallic conduits, cable terminations, junction boxes, poles, electrical equipment, and other noncurrent-carrying metallic parts of equipment shall be grounded.

15.1 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.

15.1.1 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 one foot below finished grade. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional grounds 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.

15.1.2 Connections. Connections above grade shall be made by a fusion-welding process and those below grade shall be made by a fusion-welding process. Where ground wires are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be utilized.

15.2 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 nonfence-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.

15.3 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.

15.4 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.

15.5 Handhole and Pullbox Grounding. Ground rods installed in electrical-distribution-system handholes and pullboxes shall be properly connected to the copper wire. 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. Continuous ground conductor throughout electrical distribution system using the same size conductor as indicated.

16. TESTS.

16.1 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 and the Government will furnish the necessary electric power.

16.2 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 Std 142.

17. FINISHING. Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in SECTION: PAINTING, GENERAL.

* * * * *

U.S. ARMY ENGINEER DISTRICT, LOS ANGELES
300 North Los Angeles Street
Los Angeles, California

ABSTRACT OF OFFERS – CONSTRUCTION

1. SOLICITATION NUMBER: DACW09-90-B-0029
2. DATE ISSUED: 02 JUL 90
3. DATE OPENED: 13 SEP 90
PAGE OF: 1 | 10 PAGES

4. ISSUING OFFICE
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, LOS ANGELES DISTRICT
P.O. BOX 2711 (CONTRACTING DIVISION)
LOS ANGELES, CA 90053-2325

I CERTIFY that I have opened, read, and recorded on this abstract all offers received in response to this solicitation.

SIGNATURE: James Hartman
DATE SIGNED: 9-20-90

5. PROJECT TITLE
ARIZONA CANAL DIVERSION CHANNEL
(CUDIA CITY WASH TO DREAMY DRAW,
INCLUDING CUDIA CITY WASH SEDIMENT
BASIN)
MARICOPA COUNTY, ARIZONA
NOT RESTRICTED TO SMALL BUSINESS CONCERNS"

6. NUMBER OF ADDENDA ISSUED: FOUR (4)

8. GOVERNMENT ESTIMATE (Check A, B or C and complete D, E and F.)

	A. HIRED LABOR
X	B. REASONABLE CONTRACT (Without Profit) (CIVIL)
	C. REASONABLE CONTRACT (Including Profit)

9. OFFERS

NO. 1 (LB)	NO. 2 (LB)
A. OFFEROR: SUNDT CORPORATION, 4101 E. IRVINGTON RD. TUCSON, ARIZONA 85726	A. OFFEROR: BALL, BALL & BROSAMER INC, P.O. BOX 1007, DANVILLE, CA 94526
B. BID SECURITY (Type and amount): 20%-BID BOND	B. BID SECURITY (Type and Amount): 20%-BID BOND
C. ADDENDA ACKNOWLEDGED: FOUR (4)	C. ADDENDA ACKNOWLEDGED: FOUR (4)

7A. ITEM NO.	7B. DESCRIPTION OF OFFERED ITEM / GOVERNMENT ESTIMATE	7C. EST. QUANTITY	D. UNIT	E. UNIT PRICE	F. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
1	DIVERSION AND CONTROL OF WATER	1	JOB	L.S.	$ 172,505.00	L.S.	$ 450,000.00	L.S.	$ 300,000.00
2	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	JOB	L.S.	$1,087,284.00	L.S.	$ 620,000.00	L.S.	$ 1,000,000.00
3	EXCAVATION	1789000	CY	3.99	$7,138,110.00	4.50	$8,050,500.00	9.55	$17,084,950.00
4	COMPACTED FILL, CHANNEL	429900	CY	3.28	$1,410,072.00	6.00	$2,579,400.00	3.50	$ 1,504,650.00
5	COMPACTED FILL, BACKFILL TOE	3,600	CY	2.46	$ 8,856.00	1.50	$ 5,400.00	6.00	$ 21,600.00
6	SELECT FILL	17,100	CY	3.45	$ 58,995.00	2.50	$ 42,750.00	16.00	$ 273,600.00
7	CONCRETE, INVERT EXCEPT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	73,700	CY	115.66	$8,524,142.00	90.00	$6,633,000.00	72.00	$ 5,306,400.00
8	CONCRETE, WALLS EXCEPT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	56,900	CY	137.19	$7,806,111.00	130.00	$7,397,000.00	85.00	$ 4,836,500.00
9	CONCRETE, TOP SLAB EXCEPT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	12,200	CY	193.66	$2,362,652.00	120.00	$1,464,000.00	95.00	$ 1,159,000.00
10	CONCRETE, DENTAL	300	CY	205.68	$ 61,704.00	170.00	$ 51,000.00	600.00	$ 180,000.00
11	COLOR ADMIXTURE	1	JOB	L.S.	$2,088,499.00	L.S.	$1,500,000.00	L.S.	$ 1,000,000.00

9. OFFERS *(Continued)*

NO. 3 (LB)		NO. 4		NO. 5		NO. 6		NO. 7	
A. OFFEROR THE TANNER COMPANIES P.O. BOX 52151 PHOENIX, ARIZONA 85072		A. OFFEROR		A. OFFEROR		A. OFFEROR		A. OFFEROR	
B. BID SECURITY *(Type and Amount)* 20%-BID BOND		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*	
C. ADDENDA ACKNOWLEDGED FOUR (4)		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED	
D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
L.S.	$ 500,000.00				(4)	PCL CIVIL CONSTRUCTORS, INC. (LB) 1620 W. FOUNTAINHEAD PKWY, SUITE 290 TEMPE, ARIZONA 85282		(ALT 2) $54,475,400.00	
L.S.	$2,505,000.00								
7.00	12,523,000.00				(5)	KIEWIT WESTERN CO. (LB) 2525 W. BERYL AVE, SUITE 100 PHOENIX, ARIZONA 85021		(ALT 1) $54,838,200.00	
5.00	$2,149,500.00								
6.00	$ 21,600.00				(6)	MINGUS CONSTRUCTORS ASSOCIATES (LB) P.O. BOX 1999 COTTONWOOD, AZ 86326		(ALT 2) $56,481,050.00	
6.00	$ 102,600.00								
95.00	$7,001,500.00								
125.00	$7,112,500.00								
110.00	$1,342,000.00								
150.00	$ 45,000.00								
L.S.	$1,000,000.00								

ABSTRACT OF OFFERS – CONSTRUCTION

1. SOLICITATION NUMBER	2. DATE ISSUED	3. DATE OPENED	PAGE OF
DACW09-90-B-0029	02 JUL 90	13 SEP 90	3 | 10 PAGES

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CORPS OF ENGINEERS, LOS ANGELES DISTRICT
P.O. BOX 2711 (CONTRACTING DIVISION)
LOS ANGELES, CA 90053-2325

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FOUR (4)

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C. ADDENDA ACKNOWLEDGED FOUR (4)	C. ADDENDA ACKNOWLEDGED FOUR (4)

7A. ITEM NO.	7B. DESCRIPTION OF OFFERED ITEM GOVERNMENT ESTIMATE	7C. EST. QUANTITY	D. UNIT	E. UNIT PRICE	F. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
12	PORTLAND CEMENT	26,800	CWT	76.71	$2,055,828.00	5.00	$ 134,000.00	3.50	$ 93,800.00
13	STEEL REINFORCEMENT EXCEPT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	10,170	TON	735.88	$7,483,899.60	500.00	$5,085,000.00	719.00	$7,312,230.00
14	OVERFLOW SPILLWAYS	1	JOB	L.S.	$ 100,016.00	L.S.	$ 250,000.00	L.S.	$ 200,000.00
15	ASPHALT CONCRETE PAVEMENT	4,100	TON	88.31	$ 362,071.00	60.00	$ 246,000.00	90.00	$ 369,000.00
16	STEEL PICKET FENCE	1	JOB	L.S.	$1,336,171.00	L.S.	$ 940,000.00	L.S.	$ 850,000.00
17	SIDE DRAINS	1	JOB	L.S.	$ 92,973.00	L.S.	$ 300,000.00	L.S.	$ 220,000.00
18	MISCELLANEOUS HARDWARE	1	JOB	L.S.	$ 67,185.00	L.S.	$ 50,000.00	L.S.	$ 65,000.00
19	DRIVEWAY ENTRANCES	1	JOB	L.S.	$ 12,999.00	L.S.	$ 20,000.00	L.S.	$ 3,000.00
20	STATION MARKING	1	JOB	L.S.	$ 1,322.00	L.S.	$ 5,000.00	L.S.	$ 3,000.00
21	GAGING STATION	1	JOB	L.S.	$ 13,246.00	L.S.	$ 25,000.00	L.S.	$ 15,000.00
22	CUDIA CITY WASH SPILLWAY CONDUITS	1	JOB	L.S.	$ 19,496.00	L.S.	$ 20,000.00	L.S.	$ 15,000.00
23	INTAKE STRUCTURE	1	JOB	L.S.	$ 4,854.00	L.S.	$ 5,000.00	L.S.	$ 11,000.00
24	SHOTCRETE	1	JOB	L.S.	$ 208,826.00	L.S.	$ 122,600.00	L.S.	$ 200,000.00

9. OFFERS *(Continued)*

NO. 3 (LB)		NO. 4		NO. 5		NO. 6		NO. 7	
A. OFFEROR THE TANNER COMPANIES P.O. BOX 52151 PHOENIX, ARIZONA 85072		A. OFFEROR		A. OFFEROR		A. OFFEROR		A. OFFEROR	
B. BID SECURITY *(Type and Amount)* 20%-BID BOND		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*	
C. ADDENDA ACKNOWLEDGED FOUR (4)		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED	
D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
2 5.00	$ 134,000.00								
3 600.00	$6,102,000.00								
4 L.S.	$ 150,000.00								
5 60.00	$ 246,000.00								
6 L.S.	$1,100,000.00								
7 L.S.	$ 100,000.00								
8 L.S.	$ 35,000.00								
9 L.S.	$ 15,000.00								
0 L.S.	$ 2,500.00								
1 L.S.	$ 15,000.00								
2 L.S.	$ 10,000.00								
3 L.S.	$ 15,000.00								
4 L.S.	$ 200,000.00								

ABSTRACT OF OFFERS – CONSTRUCTION

DACW09-90-B-0029 | 02 JUL 90 | 13 SEP 90 | 5 TWO PAGES

ISSUING OFFICE
DEPARMENT OF THE ARMY
CORPS OF ENGINEERS, LOS ANGELES DISTRICT
P.O. BOX 2711 (CONTRACTING DIVISION)
LOS ANGELES, CA 90053-2325

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INCLUDING CUDIA CITY WASH SEDIMENT
BASIN)
MARICOPA COUNTY, ARIZONA
"RESTRICTED TO SMALL BUSINESS CONCERNS"

NUMBER OF ADDENDA ISSUED
FOUR (4)

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B. BID SECURITY (Type and amount)	20%-BID BOND	20%-BID BOND
C. ADDENDA ACKNOWLEDGED	FOUR (4)	FOUR (4)

ITEM NO.	7B. DESCRIPTION OF OFFERED ITEM GOVERNMENT ESTIMATE	7C. EST. QUANTITY	D. UNIT	E. UNIT PRICE	F. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
5	MISCELLANEOUS ITEMS OF WORK	1	JOB	L.S.	$ 12,545.00	L.S.	$ 50,000.00	L.S.	$ 40,000.00
6	12TH STREET AND 16TH STREET UNDERPASS RAMPS	1	JOB	L.S.	$ 255,627.00	L.S.	$ 200,000.00	L.S.	$ 90,000.00
7	STONE	15,200	TON	18.37	$ 279,224.00	15.00	$ 228,000.00	11.00	$ 167,200.00
8	GROUTING STONEWORK	3,800	CY	130.21	$ 494,798.00	110.00	$ 418,000.00	55.00	$ 209,000.00
9	CURB AND GUTTER	5,900	LNFT	9.23	$ 54,457.00	7.00	$ 41,300.00	7.00	$ 41,300.00
10	LANDSCAPING	1	JOB	L.S.	$ 645,170.00	L.S.	$ 550,000.00	L.S.	$ 700,000.00
11	IRRIGATION SYSTEM	1	JOB	L.S.	$ 625,211.00	L.S.	$ 350,000.00	L.S.	$ 200,000.00
12	SUBDRAINAGE SYSTEM	1	JOB	L.S.	$ 227,297.00	L.S.	$ 300,000.00	L.S.	$ 250,000.00
13	35TH STREET WASH DRAINAGE CULVERTS	1	JOB	L.S.	$ 90,388.00	L.S.	$ 100,000.00	L.S.	$ 65,000.00
14	MANHOLE ADJUSTMENTS	1	JOB	L.S.	$ 603.00	L.S.	$ 15,000.00	L.S.	$ 10,000.00
15	32ND STREET SANITARY SEWER	1	JOB	L.S.	$ 394,941.00	L.S.	$ 200,000.00	L.S.	$ 220,000.00
16	STANFORD DRIVE RECONSTRUCTION	1	JOB	L.S.	$ 270,873.00	L.S.	$ 250,000.00	L.S.	$ 180,000.00
17	24TH STREET DETOUR	1	JOB	L.S.	$ 743,024.00	L.S.	$ 800,000.00	L.S.	$ 380,000.00
18	24TH STREET SANITARY SEWER	1	JOB	L.S.	$ 743,024.00	L.S.	$ 600,000.00	L.S.	$ 350,000.00

9. OFFERS *(Continued)*

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B. BID SECURITY *(Type and Amount)* 20%-BID BOND		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*	
C. ADDENDA ACKNOWLEDGED FOUR (4)		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED	
D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
L.S.	$ 10,000.00								
L.S.	$ 200,000.00								
20.00	$ 304,000.00								
65.00	$ 247,000.00								
10.00	$ 59,000.00								
L.S.	$ 800,000.00								
L.S.	$ 800,000.00								
L.S.	$ 100,000.00								
L.S.	$ 100,000.00								
L.S.	$ 5,000.00								
L.S.	$ 150,000.00								
L.S.	$ 350,000.00								
L.S.	$ 350,000.00								
L.S.	$ 500,000.00								

ABSTRACT OF OFFERS – CONSTRUCTION

1. SOLICITATION NUMBER	2. DATE ISSUED	3. DATE OPENED	PAGE OF
DACW09-90-B-0029	02 JUL 90	13 SEP 90	7 | 10 PAGES

4. ISSUING OFFICE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, LOS ANGELES DISTRICT
P.O. BOX 2711 (CONTRACTING DIVISION)
LOS ANGELES, CA 90053-2325

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6. NUMBER OF ADDENDA ISSUED

FOUR (4)

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B. BID SECURITY (Type and amount) 20%-BID BOND	B. BID SECURITY (Type and Amount) 20%-BID BOND
C. ADDENDA ACKNOWLEDGED FOUR (4)	C. ADDENDA ACKNOWLEDGED FOUR (4)

7A. ITEM NO.	7B. DESCRIPTION OF OFFERED ITEM	7C. EST. QUANTITY	D. UNIT	E. UNIT PRICE	F. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
39	35TH STREET SIDE DRAIN	1	JOB	L.S.	$ 444,476.00	L.S.	$ 400,000.00	L.S.	$ 320,000.00
40	LOW FLOW CHANNEL BRIDGES	1	JOB	L.S.	$ 44,180.00	L.S.	$ 75,000.00	L.S.	$ 40,000.00
41	MAINTENANCE ROAD BRIDGE	1	JOB	L.S.	$ 24,098.00	L.S.	$ 20,000.00	L.S.	$ 10,000.00
	ALTERNATE NO. 1 (CAST-IN-PLACE CONSTRUCTION)								
42A	CONCRETE, INVERT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	12,900	CY	46.86	$ 604,494.00	90.00	$1,161,000.00	N	
43A	CONCRETE, WALLS BETWEEN STA 944 +67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	12,800	CY	46.86	$ 599,808.00	130.00	$1,664,000.00	O B	
44A	CONCRETE, TOP SLAB BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	10,200	CY	20.08	$ 204,816.00	115.00	$1,173,000.00	I D	
45A	STEEL REINFORCEMENT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	2,830	TON	1256.34	$3,555,442.20	500.00	$1,415,000.00		

63¢/lb .25¢/lb

9. OFFERS *(Continued)*

NO. 3 (LB)		NO. 4		NO. 5		NO. 6		NO. 7	
A. OFFEROR THE TANNER COMPANIES P.O. BOX 52121 PHOENIX, ARIZONA 85072		A. OFFEROR		A. OFFEROR		A. OFFEROR		A. OFFEROR	
B. BID SECURITY *(Type and Amount)* 20%-BID BOND		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*	
C. ADDENDA ACKNOWLEDGED FOUR (4)		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED	
D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
L.S.	$ 550,000.00								
L.S.	$ 50,000.00								
L.S.	$ 5,000.00								
A N									
O A									
A	B I								
A	D								

GPO 1984 O - 437-438

ABSTRACT OF OFFERS – CONSTRUCTION

1. SOLICITATION NUMBER	2. DATE ISSUED	3. DATE OPENED	PAGE OF
DACW09-90-B-0029	02 JUL 90	13 SEP 90	9 | 10 PAGES

4. ISSUING OFFICE
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, LOS ANGELES DISTRICT
P.O. BOX 2711 (CONTRACTING DIVISION)
LOS ANGELES, CA 90053-2325

I CERTIFY that I have opened, read, and recorded on this abstract all offers received in response to this solicitation.

SIGNATURE | DATE SIGNED

5. PROJECT TITLE
ARIZONA CANAL DIVERSION CHANNEL
(CUDIA CITY WASH TO DREAMY DRAW,
INCLUDING CUDIA CITY WASH SEDIMENT
BASIN)
MARICOPA COUNTY, ARIZONA
"NOT RESTRICTED TO SMALL BUSINESS CONCERNS"

6. NUMBER OF ADDENDA ISSUED
FOUR (4)

8. GOVERNMENT ESTIMATE (Check A, B or C and complete D, E and F.)

	A. HIRED LABOR
X	B. REASONABLE CONTRACT (Without Profit) (CIVIL)
	C. REASONABLE CONTRACT (Including Profit)

9. OFFERS

NO. 1 (LB)	NO. 2 (LB)
A. OFFEROR SUNDT CORPORATION 4101 E. IRVINGTON RD. TUCSON, ARIZONA 85726	A. OFFEROR BALL, BALL & BROSAMER INC P.O. BOX 1007 DANVILLE, CA 94526
B. BID SECURITY (Type and amount) 20%-BID BOND	B. BID SECURITY (Type and Amount) 20%-BID BOND
C. ADDENDA ACKNOWLEDGED FOUR (4)	C. ADDENDA ACKNOWLEDGED FOUR (4)

7A. ITEM NO.	7B. DESCRIPTION OF OFFERED ITEM GOVERNMENT ESTIMATE	7C. EST. QUANTITY	D. UNIT	E. UNIT PRICE	F. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
	ALTERNATE NO. 2 (PRECAST CONSTRUCTION)								
42B	CONCRETE, INVERT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	14,900	CY	46.86	$ 698,214.00	95.00	$1,415,500.00	72.00	$1,072,800.00
43B	CONCRETE, WALLS BETWEEN STA 944 +67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	9,200	CY	20.08	$ 184,736.00	135.00	$1,242,000.00	85.00	$ 782,000.00
44B	PRESTRESSED BOX BEAMS	765	EA	222.94	$ 170,549.10	2600.00	$1,989,000.00	2000.00	$1,530,000.00
45B	STEEL REINFORCEMENT BETWEEN STA 944+67 AND STA 919+00.5 AND BETWEEN STA 909+28 AND 904+20	1,470	TON	1256.34	$1,846,819.80	450.00	$ 661,500.00	720.00	$1,058,400.00
	TOTAL ESTIMATED AMOUNT (INCLUDING ALTERNATE NO. 1)				52,792,312.80		46,005,950.00	N / A	
	TOTAL ESTIMATED AMOUNT (INCLUDING ALTERNATE NO. 2)				50,728,071.50		45,900,950.00		49,739,430.00

9. OFFERS *(Continued)*

NO. 3 (LB)		NO. 4		NO. 5		NO. 6		NO. 7	
A. OFFEROR THE TANNER COMPANIES P.O. BOX 52151 PHOENIX, ARIZONA 85072		A. OFFEROR		A. OFFEROR		A. OFFEROR		A. OFFEROR	
B. BID SECURITY *(Type and Amount)* 20%-BID BOND		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*		B. BID SECURITY *(Type and Amount)*	
C. ADDENDA ACKNOWLEDGED FOUR (4)		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED		C. ADDENDA ACKNOWLEDGED	
D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT	D. UNIT PRICE	E. ESTIMATED AMOUNT
42B 95.00	$1,415,500.00								
3B 125.00	$1,150,000.00								
4B 3200.00	$2,448,000.00								
5B 600.00	$ 882,000.00								
OTAL ALT 1	N/A								
OTAL ALT 2	52,902,700.00								