

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. AMENDMENT/MODIFICATION NO. NO. 2	2. EFFECTIVE DATE 31 July 84	3. REQUISITION/PURCHASE REQUEST NO.	4. PROJECT NO. (If applicable) Spec. 05-82-4643
5. ISSUED BY Officer in Charge of Construction Jacksonville, North Carolina Area Building 1005, Marine Corps Base Camp Lejeune, North Carolina 28542		6. ADMINISTERED BY (If other than block 5)	

7. CONTRACTOR NAME AND ADDRESS (Street, city, county, state, and ZIP Code)	CODE	FACILITY CODE	8. AMENDMENT OF SOLICITATION NO. N62470-82-B-4643 DATED 25 July 1984 (See block 9) MODIFICATION OF CONTRACT/ORDER NO. DATED (See block 11)
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9. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in block 12. The hour and date specified for receipt of Offers is extended, is not extended.

Offerors must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended, by one of the following methods:

(a) By signing and returning _____ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If, by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

10. ACCOUNTING AND APPROPRIATION DATA (If required)

11. THIS BLOCK APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS

(a) This Change Order is issued pursuant to _____
The Changes set forth in block 12 are made to the above numbered contract/order.

(b) The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation data, etc.) set forth in block 12.

(c) This Supplemental Agreement is entered into pursuant to authority of _____
It modifies the above numbered contract as set forth in block 12.

12. DESCRIPTION OF AMENDMENT/MODIFICATION

CONSTRUCT BACKWASH WASTE TANKS
at the
MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA

NAVFAC DRAWINGS 4088849 THROUGH 4088860 INCLUSIVE

Add the following note to each drawing:

"THIS DRAWING IS APPROXIMATELY
A 1/2 SIZE REDUCTION
GRAPHIC SCALES SHOWN HEREON APPLY."

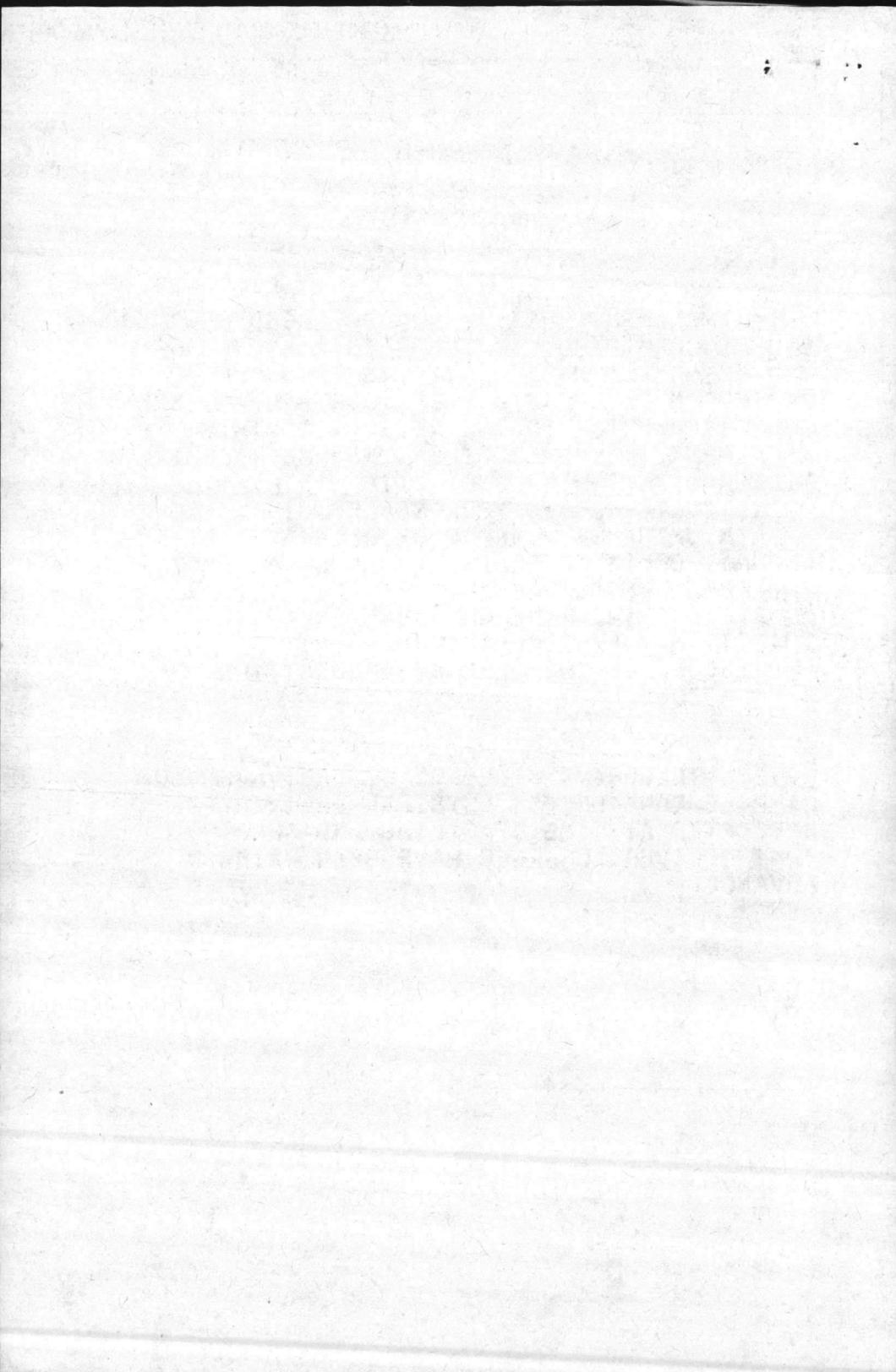
Except as provided herein, all terms and conditions of the document referenced in block 8, as heretofore changed, remain unchanged and in full force and effect.

13. <input type="checkbox"/> CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT		<input type="checkbox"/> CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN _____ COPIES TO ISSUING OFFICE	
14. NAME OF CONTRACTOR/OFFEROR	BY _____ (Signature of person authorized to sign)	17. UNITED STATES OF AMERICA BY M. L. ENNETT By direction (Signature of Contracting Officer)	
15. NAME AND TITLE OF SIGNER (Type or print)	16. DATE SIGNED	18. NAME OF CONTRACTING OFFICER (Type or print) C. A. JOHANNESMEYER, CDR, CEC, USN for COMNAVFACENCOM	19. DATE SIGNED 31 July 84

IMPORTANT

THIS AMENDMENT MUST BE ACKNOWLEDGED WHEN YOUR BID IS SUBMITTED. FAILURE TO ACKNOWLEDGE THE AMENDMENT MAY CONSTITUTE GROUNDS FOR REJECTION OF THE BID. IF YOUR BID HAS BEEN SUBMITTED PRIOR TO THE RECEIPT OF THIS AMENDMENT, ACKNOWLEDGEMENT MAY BE MADE BY TELEGRAM, WHICH SHOULD STATE WHETHER THE PRICE CONTAINED IN YOUR SEALED BID IS TO REMAIN UNCHANGED, IS TO BE DECREASED BY AN AMOUNT, OR IS TO BE INCREASED BY AN AMOUNT. THE ACKNOWLEDGEMENT MUST BE RECEIVED PRIOR TO BID OPENING TIME UNLESS THERE IS EVIDENCE THAT IT MAY BE ACCEPTED PURSUANT TO THE PROVISIONS OF THE DEFENSE ACQUISITION REGULATIONS.

NOTE: TELEGRAMS WILL NOT BE DELIVERED TO CAMP LEJEUNE UNLESS PHYSICAL DELIVERY IS SPECIFIED AT TIME OF FILING AND SHOWING THAT DELIVERY CHARGES HAVE BEEN PAID IN ADVANCE.



AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. AMENDMENT/MODIFICATION NO. NO. 1		2. EFFECTIVE DATE 23 July 84	3. REQUISITION/PURCHASE REQUEST NO.	4. PROJECT NO. (If applicable) Spec. 05-82-4643
5. ISSUED BY Officer in Charge of Construction Jacksonville, North Carolina Area Building 1005, Marine Corps Base Camp Lejeune, North Carolina 28542		CODE	6. ADMINISTERED BY (If other than block 5) CODE	
7. CONTRACTOR NAME AND ADDRESS (Street, city, county, state, and ZIP Code)		CODE	8. AMENDMENT OF SOLICITATION NO. N62470-82-B-4643 DATED NOT YET ISSUED (See block 9) MODIFICATION OF CONTRACT/ORDER NO. DATED (See block 11)	

9. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS
 The above numbered solicitation is amended as set forth in block 12. The hour and date specified for receipt of Offers is extended, is not extended.
 Offerors must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended, by one of the following methods:
 (a) By signing and returning _____ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If, by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

10. ACCOUNTING AND APPROPRIATION DATA (If required)

11. THIS BLOCK APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS
 (a) This Change Order is issued pursuant to _____
 The Changes set forth in block 12 are made to the above numbered contract/order.
 (b) The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation data, etc.) set forth in block 12.
 (c) This Supplemental Agreement is entered into pursuant to authority of _____
 It modifies the above numbered contract as set forth in block 12.

12. DESCRIPTION OF AMENDMENT/MODIFICATION
 CONSTRUCT BACKWASH WASTE TANKS
 at the
 MARINE CORPS BASE - CAMP LEJEUNE, NORTH CAROLINA

SPECIFICATION

COVER SHEET: In the upper left hand corner under "NOTICE:" insert -

Bids to opened at 2:00 P.M.
 30 August 1984 at the office of
 Officer in Charge of Construction
 Jacksonville, North Carolina Area
 Building 1005, Marine Corps Base
 Camp Lejeune, North Carolina 28542

Except as provided herein, all terms and conditions of the document referenced in block 8, as heretofore changed, remain unchanged and in full force and effect.

13. <input type="checkbox"/> CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT		<input type="checkbox"/> CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN _____ COPIES TO ISSUING OFFICE	
14. NAME OF CONTRACTOR/OFFEROR BY _____ (Signature of person authorized to sign)		17. UNITED STATES OF AMERICA BY M. L. ENNETT By direction (Signature of Contracting Officer)	
15. NAME AND TITLE OF SIGNER (Type or print)	16. DATE SIGNED	18. NAME OF CONTRACTING OFFICER (Type or print) C. A. JOHANNESMEYER, CDR, CEC, USN for COMNAVFACENGCOM	19. DATE SIGNED 23 July 1984

SECTION 00101. BIDDING INFORMATION

2.3 Items of Bids: Line 3, Delete "with Appendix 'A'".

3. Pre-Bid Site Visitation: Line 3, Change the telephone number to read "(919) 451-2582".

SECTION 01011

GENERAL PARAGRAPHS

6. DRAWINGS ACCOMPANYING SPECIFICATION: After this paragraph, insert the following new paragraphs:

"6.1 REFERENCE DRAWINGS ACCOMPANYING SPECIFICATION: The following Pollution Control Co. drawings are to be used as reference drawings and accompany this specification and are intended only to show the government furnished equipment at the mechanical clarifier. Drawings are the property of the Government and shall not be used for any purpose other than that contemplated by the specification. The Contractor is responsible for ascertaining by on-site inspection any changes to be made in the equipment shown or related contract drawings and to reflect such changes in bids accordingly.

<u>DWG NO.</u>	<u>TITLE</u>
P-10159L	Pollution Control Inc. Mechanical Collector

80-77 Mechanical Collector Equipment for Camp Lejeune"

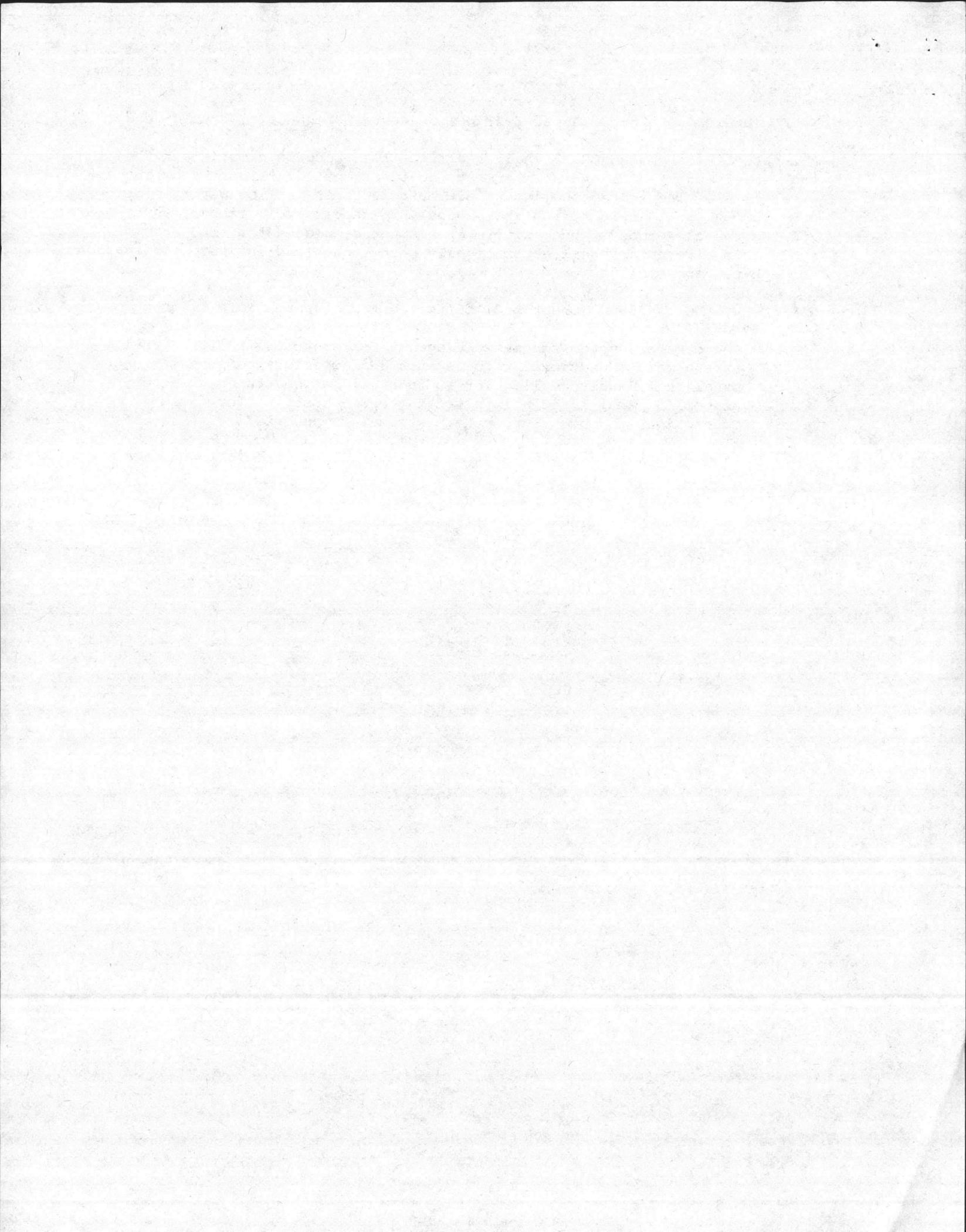
14.1 GOVERNMENT FURNISHED EQUIPMENT: Delete pages 01011-5 and 01011-6, in their entirety and substitute replacement pages 01011-5, 01011-6 and 01011-7 enclosed with this amendment.

NAVFAC DWG. NO. 408859 (Sheet E-2) bottom center of sheet, 7 should read.

"7. BUBBLER SYSTEM NUMBER 2 shall start the lead recycle pump, start the lag recycle pump and sound an alarm at the indicated points on the rising water level. The system shall shut off both pumps at the low water point and, through an interlock with the sludge pump repeat cycle timer, shut off the recycle pumps if the cam timer has not completed the sludge pump cycle. An alternator shall automatically change the lead-lag pump combination on each pumping cycle".

NAVFAC DWG. NO. 408859 (Sheet E-3) bottom center of sheet Note 1. should read - "Note 1.

See control system schematic diagrams for control circuits, panel arrangement, functional requirements and accessory components panel shall include all power and control components in a factory assembled panel internally wired to terminal strips for field connections to motors and other external components".



25	5	8" M.J. Flanges	
26	1	8 x 8 Mech. Y	
27	2	30" Wall Sleeve	
28	2	8" Flanged Tee	
29	1	12"x 6" Tapping Saddle/Valve	
30	5	8" Flanges	
31	2	4" Gate Valve	
32	3	3" 45 Degree Bend	
33	1	3" Through Wall Sleeve	
34	1	4"x 3" Reducer	
35	2	Electric Lift Posts (Sluice Gate)	*
36	2	Crank Lift Posts (Sluice Gate)	*
37	2	30" Sluice Gate	
38	2	12" Sluice Gate	
39	2	12" Wall Thimble	
40	2	30" Wall Thimble	
41	4	Sluice Gate Operating Rods	
42	90 LF	18" DIP	
43	54 LF	8" DIP	
44	60 LF	3" DIP	
45	20 LF	2" Copper Pipe	
46	1	Clairifier Control Panel	*
47		Pre-cast Manholes	

Sections of eight pre-cast manholes as listed below will be provided to the contractor for installation. All eight manholes require additional riser sections or tops and rework of pipe openings for revised pipe sizes and configuration. It will be the responsibility of the contractor to field verify the vertical and horizontal dimensions of these structures, and submit to the Contracting Officer for his approval the proposed method of modification prior to installation.

MANHOLE	INSIDE DIA	SECTIONS FURNISHED			VERTICAL SEC. REQUIRED
		BASE	RISER	TOP	
"A"	60"	1	0	1	2.25 Feet
"B"	60"	1	1	0	1.42 Feet
"C"	72"	1	0	1	1.22 Feet
"D"	60"	1	0	1	1.98 Feet
"E"	48"	1	1	0	1.33 Feet
"F"	60"	1	0	1	4.14 Feet
"I"	60"	1	0	1	2.25 Feet
#1	72"	1	0	1	4.63 Feet

The pre-cast manhole sections are stored within two miles of the Water Treatment Plant and the contractor will be responsible for transporting this material to the construction site.

Mechanical Clarifier Equipment.

48	1	Gear Reducer/Stand	*
49	1	Extended Shaft	*
50	2	Torque Limiter	*
51	2	Pillow Block Bearings with Stand	*
52	2	Adjusto-Screw Tensioners	*
53	2	Drive Unit Chain	*
54	1	Drive Sprocket	*
55	8	Shafts	*
56	12	Wall Bearings	*
57	16	Chain Sprocket	*
58	4	Take Up Bearings	*
59	4	Drag Chain	*
60	18	Redwood Flights	*
61	4	Slide Rails	*
62	10	Collector Chain Links (Spare Part)	*
63	4	Chain Attachment Links(Spare Part)	*
64	1	Drive Chain(Spare Part)	*
65	4	Drive Links(Spare Part)	*
66	(50%)	Flight Wear Shoes with Hardware(Spare Part)	*

SITE MCAS (E) NEW RIVER AIR STATION

1	2	Submersible Pumps	
2	2	Quick Disconnects	
3	2	Pump Base and Ells	
4	4	Pump Level Control Systems	
5	1	Access Hatch and Frame	
6	2	Guide Rails and Braces	
7	1	Wiring Channel and Flexible Pump Cables	
8	4	Dresser Coupling	
9	2	3" Check Valve	
10	2	3" Gate Valve	
11	1	Electrical Control Panel	*
12	50 LF	3" DIP	
13	3	3" 90 Degree Ell Flanged	
14	1	3" Flanged Tee	
15	2	4"x 3" Flanged Reducer	
16	6	3" Flanged and P.E. Pieces	
17	25 LF	8" DIP	
18	1	8" M.J. 90 Degree Bend	
19	2	8" Wall Sleeves	

NOTE (SITE V11-9)

The Mechanical Clarifier equipment furnished to the contractor for installation was manufactured or provided by Pollution Control, Inc., 10360 Wayne Ave. Cincinnati OH 45215 Telephone 513 / 772-1330. All additional equipment needed to provide a complete and operating system should be approved or provided by Pollution Control Inc.

"15. AS-BUILT DRAWINGS: During the progress of the work one full-size print of each of the drawings accompanying this specification shall be neatly and clearly marked in red to show all variations between the construction actually provided and that indicated or specified in the contract documents. The as-built drawings shall be kept up-to-date at the work site at all times during the contract, and shall be available for inspection by the Contracting Officer upon request. The Contractor shall also mark the drawings to indicate the exact location of any underground utility lines discovered in the course of the work. Where a choice of materials or methods, or both, is permitted herein, and where variations in the scope or character of the work indicated or specified are permitted either by award on bidding items specified for that purpose or by subsequent change to the contract, the as-built drawings shall define the construction actually provided. The representation of such variations shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as may be necessary for legibility and clear portrayal of the as-built construction; the marked prints shall be subject to approval of the Contracting Officer before acceptance. Upon completion of the work, the completed as-built drawings shall be presented to the Contracting Officer.

END OF SECTION

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND
NAVAL STATION, NORFOLK, VIRGINIA

NOTICE:

NAVFAC
SPECIFICATION
NO. 05-82-4643

Appropriation: MCON

CONSTRUCT BACKWASH WASTE TANKS
at the
MARINE CORPS BASE - CAMP LEJEUNE, NORTH CAROLINA

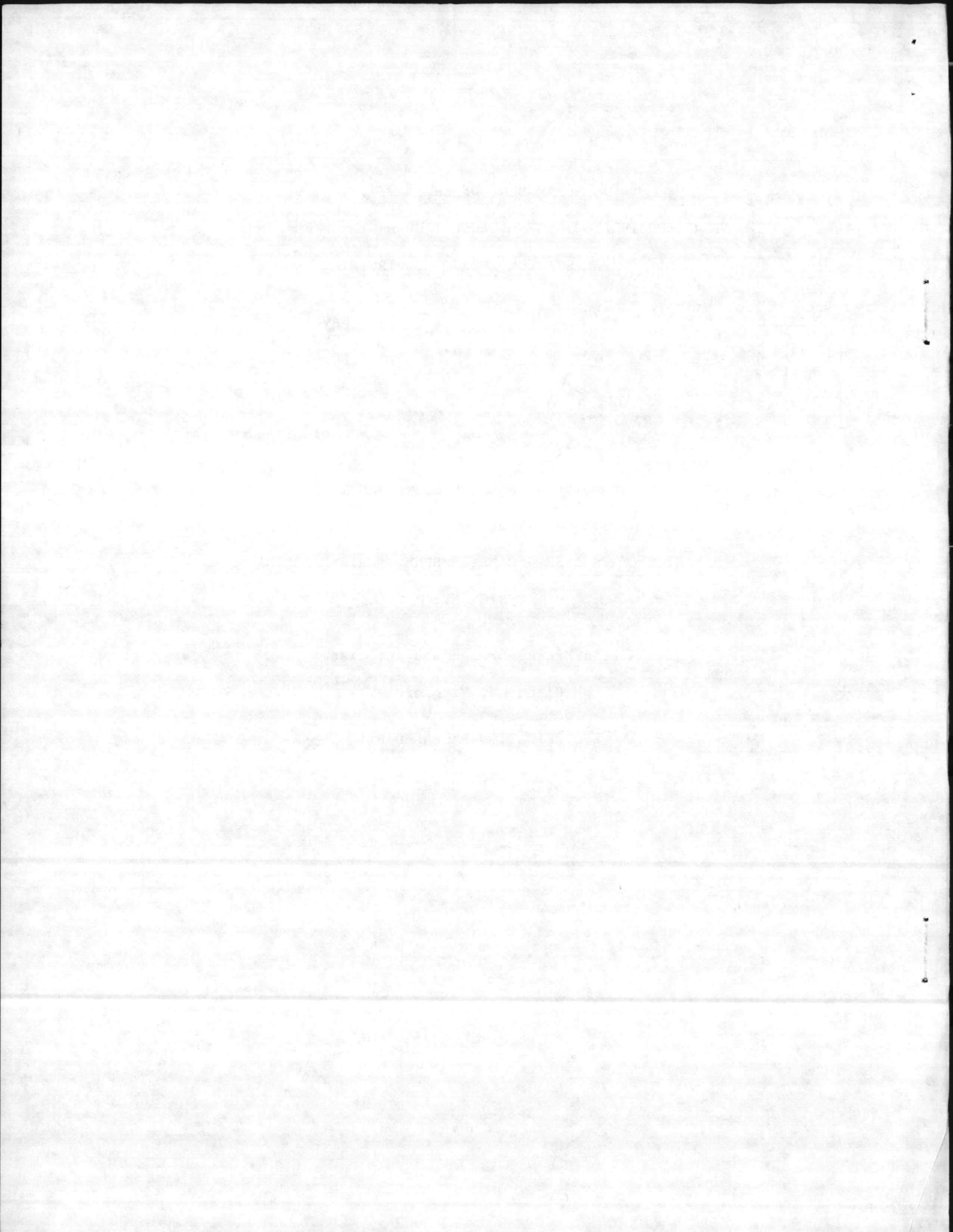
DESIGN BY:

Austin Brockenbrough and Associates
Richmond, Virginia

SPECIFICATION PREPARED BY:

Gary R. Horne

05-82-4643



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SECTION 00101
BIDDING INFORMATION

1. CONTENTS: This Invitation for Bids, IFB NO.N62470-82-B-4643, consists of the following documents:

(a) Bid Instruction Documents

- (i) Invitation for Bids (Standard Form 20, January 1961 Ed.)
- (ii) Bidding Information
- (iii) Instructions to Bidders, dated March 1979

(b) Bid Submittal Documents

- (i) Bid Form (Standard Form 21, December 1965 Ed.)
- (ii) Representations and Certifications, Standard Form 19-B, June 1976 Ed. (REV 1982 DEC)
- (iii) Bid Guaranty (Standard Form 24, June 1964 Ed.)
(See Instructions to Bidders)

(c) Contract Documents

- (i) Construction Contract (Standard Form 23, Jan 1961 Ed.)
- (ii) Performance Bond (Standard Form 25, June 1967 Ed.)
- (iii) Payment Bond (Standard Form 25A, June 1964 Ed.)
- (iv) Labor Standards Provisions, dated November 1979 (Rev. 8-83)
- (v) General Provisions dated March 1981 (Rev 8/83)
- (vi) NAVFAC Specification No. 05-82-4643
- (vii) Drawings identified in Section 01011 of the specifications
- (viii) Wage Determination Decision NC84-1004, Water and Sewer Construction

2. BIDS:

2.1 INSTRUCTIONS TO BIDDERS: Instructions to Bidders and Invitation for Bids, Standard Form 20, January 1961 edition, shall be observed in the preparation of bids. Bidders shall affix their names and return addresses in the upper left corner of bid envelope. Envelopes containing bids must be sealed.

2.2 BID GUARANTY: For bids of \$25,000 or greater, a bid guaranty will be required as stipulated in the Instructions to Bidders.

2.3 ITEMS OF BIDS: Bids shall be submitted in duplicate on Standard Form 21, Bid Form, and shall be accompanied by Standard Form 19B, Representations and Certifications, and by Bid Guaranty, all in accordance with the Bid Instruction Documents listed in paragraph 1(a) hereinbefore upon the following item:

BASE BID: Price for the entire work, complete in accordance with the drawings and specifications.

2.4 TELEGRAPHIC MODIFICATIONS OF BIDS in accordance with the instructions to bidders may be made. Two signed copies of the telegram in a sealed envelope marked "Copies of telegraphic modification of bid for CONSTRUCT BACKWASH SURGE TANKS, Specification No. 05-82-4643", should be forwarded immediately to the office to which written bids were submitted.

2.5 TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS will be considered as specified herein. TELEPHONIC RECEIPT OF TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS WILL NOT QUALIFY THE TELEGRAM AS TIMELY. The telegram must be received at the place specified for receipt of bids prior to the exact time set for receipt of bids.

2.6 HAND DELIVERED BIDS: All hand delivered bids must be deposited with personnel in the Contract Branch, Room No. 26, Building 1005, Marine Corps Base, Camp Lejeune, North Carolina 28542, prior to the time and date set for bid opening. Any bids submitted by hand after the time set for receipt will not be accepted.

3. PRE-BID SITE VISITATION: To inspect the site of the work prior to bid opening, prior appointment must be made with the Officer in Charge of Construction, Jacksonville, North Carolina Area, telephone 919-451-2581. Bidders are urged and expected to inspect the site where the services are to be performed and to satisfy themselves as to all general and local conditions that may affect the cost of performance of the contract to the extent such information is reasonably obtainable. In no event will a failure to inspect the site constitute grounds for withdrawal of a bid after opening or for a claim after award of the contract.

4. CONTROLLED MATERIALS DATA: The Contracting Officer will issue a DO-C2 priority rating for procurement of critical materials. See General Provision entitled "PRIORITIES, ALLOCATIONS AND ALLOTMENTS".

5. INQUIRIES:

5.1 PLANS AND SPECIFICATIONS: Questions regarding the plans and specifications occurring prior to bid opening shall be presented to the Public Works Design Division, Building 1005, Marine Corps Base, Camp Lejeune, North Carolina 28542, telephone 919-451-5507. Questions requiring interpretation of drawings and specifications must be submitted at least ten days before bid opening. Interpretations or modifications to specifications made as a result of questions will be made by amendment only, and unless so done, all bidders should base their bids on the plans and specifications as issued.

5.2 BIDDING PROCEDURES: All questions concerning the bidding procedures shall be presented to OICC-ROICC Contract Branch, Room 26, Building 1005, Marine Corps Base, Camp Lejeune, North Carolina, telephone 919-451-2582.

6. AVAILABILITY OF SPECIFICATIONS, STANDARDS AND DESCRIPTIONS (1977 JUN):
Specifications, standards and descriptions cited in this solicitation are available as indicated below:

a. Unclassified Federal, Military and Other Specifications and Standards (Excluding Commercial), and Data Item Descriptions: Submit request on DD Form 1425 (Specifications and Standards Requisition) to:

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

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

b. Commercial Specifications, Standards and Descriptions: These specifications, standards and descriptions are not available from Government sources. They may be obtained from the publishers.

c. Availability for Examination of Specifications, Standards, Plans, Drawings, and other Pertinent Documents: The specifications, standards, plans, drawings, and other pertinent documents cited in this solicitation may be examined at the following location:

Public Works Division
Specifications and Estimates Section
Building 1005, Marine Corps Base
Camp Lejeune, North Carolina

7. RECOVERED MATERIAL: The Contractor certifies by signing this bid/proposal/quotation that recovered materials as defined in DAR 1-2500.4 will be used as required by the applicable publications.

8. REFERENCE TO AMENDMENTS: Each bidder shall refer in his bid to all amendments to this specification; failure to do so may constitute an informality in the bid.

9. CERTIFICATE OF CURRENT COST OR PRICING DATA: (This paragraph applies to negotiated contracts of \$500,000 or more, except where the price is based on adequate competition, and to change orders of \$500,000 or more, to any contract.) The Contractor shall submit to the Contracting Officer a certificate in the form set forth below as soon as practicable after agreement is reached on the contract price:

This is to certify that, to the best of my knowledge and belief, cost or pricing data defined in DAR 3-807.1(a)(1) submitted, either actually or by specific identification in writing (see DAR 3-807.3(a)) to the Contracting Officer or his representative in support of _____*
are accurate, complete, and current as of _____**
day month year

This certification includes the cost or pricing data supporting any advance agreement(s) and forward pricing rate agreements between the offeror and the Government which are part of the proposal.

Firm _____
Name _____
Title _____

Date of Execution

*Describe the proposal, quotation, request for price adjustment or other submission involved, giving appropriate identifying number (e.g. RFP No. _____).

**The effective date shall be the date when price negotiations were concluded and the contract price was agreed to. The responsibility of the Contractor is not limited by the personal knowledge of the Contractor's negotiator if the Contractor had information reasonably available at the time of agreement, showing that the negotiated price is not based on accurate, complete and current data.

***This date should be as close as practicable to the date when the price negotiations were concluded and the contract price was agreed to.

END OF SECTION

SECTION 01011
GENERAL PARAGRAPHS

1. GENERAL INTENTION: It is the declared and acknowledged intention and meaning to provide and secure two backwash waste tanks, complete and ready for use. This is a fixed-price contract awarded on a lump sum basis.

2. GENERAL DESCRIPTION: The work includes providing two in-ground concrete tank structures, mechanical waste handling equipment, pumps, electrical equipment, and incidental related work.

2.1 SPECIAL DEWATERING REQUIREMENTS: Site VII-9 will require a dewatering system of sheet piling and pumps to maintain dry and workable conditions until all subsurface work is completed. A dewatering and groundwater monitoring plan is required and is specified in Section 02200.9, "Dewatering". The dewatering plan must be submitted prior to construction start. Site MCAS(E) will require sheet piling, well-pointing, or some approved method of dewatering. The Contractor shall be responsible for developing and submitting a dewatering plan for MCAS(E) prior to construction start.

3. LOCATION: The work shall be located at the Marine Corps Base, Camp Lejeune N.C. and at the Marine Corps Air Station (Helicopter), New River, approximately as shown. The exact location will be indicated by the Contracting officer.

4. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK: The contractor will be required to commence work under the contract 15 calendar days after the date of receipt of Notice of Award, to prosecute said work diligently, and to complete the entire work ready for use within 270 calendar days. The time stated for completion shall include final cleanup of the premises. The contract completion date will be computed starting 15 calendar days after the date of Notice of Award. This 15-day period is to allow for mailing of the notice of Award and the Contractor's submission of required bonds.

5. LIQUIDATED DAMAGES: In case of failure on the part of the Contractor to complete the work within the time fixed in the contract or any extensions thereof, the Contractor shall pay to the Government as liquidated damages pursuant to General Provisions clauses entitled "Termination for Default - Damages for Delay - Time Extensions", and "Damages for Delay -- Defense Materials System and Priorities" the sum of \$65 for each day of delay.

6. DRAWINGS ACCOMPANYING SPECIFICATIONS: The following drawings accompany this specification and are a part thereof. Drawings are the property of the Government and shall not be used for any purpose other than that contemplated by the specification.

<u>NAVFAC</u> <u>DWG.NO.</u>	<u>SHEET</u> <u>NUMBER</u>	<u>TITLE</u>
4088849	CS-1	Location and Vicinity Map
4088850	C-1	Site Plan, VII-9
4088851	C-2	Site Plan, MCAS(E)
4088852	S-1	Typical Details - Tanks

4088853	S-2	Backwash Tank, VII-9
4088854	S-2a	Backwash Tank, VII-9
4088855	M-1	Mechanical, VII-9
4088856	M-2	Mechanical; VII-9
4088857	M-3	Mechanical Details
4088858	E-1	Electrical Site; VII-9 and MCAS(E)
4088859	E-2	Control Schematics, VII-9
4088860	E-3	Electrical Schedules and Details

6.1 All references in these specifications to Contract N62470-78-C-8268 or Specification No. 05-78-8268 should be deleted and N62470-82-C-4643 or 05-82-4643 inserted.

7. NORTH CAROLINA SALES AND USE TAX IS REQUIRED. (See section entitled "Additional General Paragraphs").

8. SCHEDULING THE WORK:

8.1 General Scheduling Requirements: Notwithstanding the requirements of clause entitled "Progress Charts and Requirements for Overtime work" of the General Provisions, immediately after award the Contractor shall meet with the Contracting Officer and present a schedule of work, prepared in accordance with said clause, for review by the Contracting Officer. The schedule will be reviewed at this meeting and will be retained by the Contracting Officer for final review and approval.

8.2 work Outside Regular Hours: If the Contractor desires to carry on work outside regular hours or on Saturdays, Sundays, or holidays, he shall submit application to the Contracting Officer, but shall allow ample time to enable the Government to make satisfactory arrangements for inspecting the work in progress. At night he shall light the different parts of the work in an approved manner. All utility cutovers shall be made after normal working hours or on weekends. Anticipated costs shall be included in the bid. Regular working hours are 7:30 A.M. to 4:00 P.M., Monday through Friday, excluding holidays.

8.3

9. SAFETY PROGRAM: The Contractor shall implement a safety program conforming to the requirements of Federal, State and local laws, rules and regulations. The program shall include, but is not limited to, the following:

a. "Occupational Safety and Health Standards" which can be examined at the office of the Contracting Officer or be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

b. Department of the Army, Corps of Engineers "General Safety Requirements" which may be examined at the office where bids are being received or may be purchased from the Superintendent of Documents, U. S. Government Printing Office.

c. General Provisions clause entitled "Accident Prevention".

d. NFPA 241-1975, Safeguarding Building Construction and Demolition Operations, which may be examined in the Design Branch, Public Works Division, Building 1005, Marine Corps Base, Camp Lejeune, or may be purchased from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210

10. FACTORY INSPECTION of material and equipment for which tests at the place of manufacture are required in referenced publications will be waived if notarized copies of factory reports are furnished that show compliance with the specification requirements. Factory inspection will be required only where specified herein or in the technical sections of this specification. The Government reserves the right to charge to the Contractor any additional cost of Government inspection and tests when materials and equipment are not ready at the time inspection and tests are required by the Contractor.

11. TRAILER OR STORAGE BUILDINGS will be permitted on the job site, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be suitably painted and kept in a good state of repair. Failure of the Contractor to maintain his trailers or storage buildings in good condition will be considered sufficient reason to require their removal from the job site.

12. WRITTEN GUARANTIES AND GUARANTOR'S LOCAL REPRESENTATIVE: Prior to completion of the contract, the Contractor shall obtain and furnish to the Contracting Officer's designated representative, written guarantees for all equipment and/or appliances furnished under the contract. The Contractor shall furnish with each guarantee the name, address and telephone number of the guarantor's representative nearest to the location where the equipment and/or appliances are installed, who, upon request of the using service's representative, will honor the guarantee during the guaranty period and will provide the services prescribed by the terms of the guarantee. At the time of installation, the Contractor shall tag each item of warranted equipment with a durable oil and water resistant tag approved by the Contracting Officer. Leave the date of acceptance and inspector's signature blank until the project is accepted for beneficial occupancy. The tag shall show the following information:

EQUIPMENT WARRANT TAG

Type of Equipment _____

Accepted Date _____

Warranted Until _____

Under Contract No. N62470-

Inspector's Signature _____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

13. MATERIALS AND EQUIPMENT TO BE SALVAGED: General Provision clauses entitled "Salvage Materials and Equipment" is hereby deleted. Except where specifically specified otherwise herein, all existing materials and equipment which are required to be removed or disconnected to perform the work, but are not indicated or specified for use in the new work, shall become the property of the Contractor and shall be removed from Government property.

14. GOVERNMENT-FURNISHED MATERIALS AND EQUIPMENT: The Government will furnish the material and equipment listed herein for installation by the Contractor in accordance with Clause entitled " Government-Furnished Property" of the General Provisions. A portion of the materials will be stored within two miles of the job site. The Contractor shall load, transport, unload, uncrate, assemble, install, connect, and test all Government-furnished materials and equipment. The Government-furnished material shall be inventoried in the presence of the Contracting Officer to determine any damaged or missing material. The Contractor will be responsible for field cleaning and painting equipment in accordance with Section 15011. The equipment requiring cleaning and painting is designated on the List of Government-furnished Equipment by the symbol (*).

14.1 GOVERNMENT FURNISHED EQUIPMENT:

SITE VII-9

	<u>QUANTITY</u>	<u>DESCRIPTION</u>	<u>CLEAN/PAINT</u>
1	1	Panel MCP	*
2	1	Panel R	*
3	3	30 AMP 3 P NF 480 V N-1 Disconnect	*
4	2	30 AMP 3 P NF 480 V 3-R Disconnect	*
5	1	100 AMP 3 P NF 480 V 3-R Disconnect	*
6	1	15 KVA Transformer	*
		Metal Frames and Grates (Shop Drwgs to be provided)	
7	2	G-14 with frame	
8	4	G-12 with frame	
9	4	G-11 with frame	
10	1	G-7 with frame	
11	1	G-15 with frame	
12	2	G-13 with frame	
13	3	G-5 with frame	
14	1	G-6 with frame	
15	1	Structural Steel For Landing at Off-set Ladder(C8x11.5)	
16	2	Ladders and Safety Chains	
17	21	Steel Steps (Pump Pit)	
18	150 LF	6" Waterstop	
19	20	Handrail Connectors	
20	2	Wall Vents	
21	1	Wall Exhaust Fan	*
22	1	Roof Exhaust Fan	*
23	2	Sludge Pumps	
24	2	8" 90 Degree Bend Flanged	

25	5	8" M.J. Flanges	
26	1	Discharge Pump Pipe Support	
27	1	8 x 8 Mech. Y	
28	2	30" Wall Sleeve	
29	2	8" Flanged Tee	
30	1	12"x 3" Tapping Saddle/Valve	
31	1	8" 90 Degree Bend (M.J.)	
32	2	8" x 4" Concentric Reducer	
33	3	3" Dresser Coupling	
34	2	4" 90 Degree Bend (Flanged)	
35	1	2" Check Valve	
36	1	2" Gate Valve(Screwed)	
37	1	1-1/2" Mal. Union	
38	1	1-1/2" 90 Degree Bend	
39	1	3" Flanged Cross	
40	5	8" Flanges	
41	2	4" Gate Valve	
42	4	3" 45 Degree Bend	
43	2	8" Wall Sleeve	
44	1	3"Through Wall Sleeve	
45	2	4"x 3" Reducer	
46	1	3" Wall Sleeve	
47	2	3" Check Valve	
48	2	3" Gate Valve	
49	6	Pipe Braces (1-1/2 x 1-1/2 Angle)	
50	2	Electric Lift Posts (Sluice Gate)	*
51	2	Crank Lift Posts (Sluice Gate)	*
52	2	30" Sluice Gate	
53	2	12" Sluice Gate	
54	2	12" Wall Thimble	
55	2	30" Wall Thimble	
56	2	8" Check Valve	
57	2	8" Gate Valve	
58	4	Sluice Gate Operating Rods	
59	90 LF	18" DIP	
60	54 LF	8" DIP	
61	60 LF	3" DIP	
62	42 LF	2" Galv. Pipe	
63	20 LF	8" DIP (1 Pcs. Piping in Pump Pit)	
64	20 LF	2" Copper Pipe	
65	1	2" Gate Valve (Copper)	
66	1	2" Tee (Copper)	
67	144 LF	Tee Rail	
68	1	Clairifier Control Panel	*
69		Pre-cast Manholes	

Sections of eight pre-cast manholes as listed below will be provided to the contractor for installation. All eight manholes require additional riser sections or tops and rework of pipe openings for revised pipe sizes and configuration. It will be the responsibility of the contractor to field verify the vertical and horizontal dimensions of these structures, and submit to the Contracting Officer for his approval the proposed method of modification prior to installation.

MANHOLE	INSIDE DIA	SECTIONS FURNISHED			VERTICAL SEC. REQUIRED
		BASE	RISER	TOP	
"A"	60"	1	0	1	2.25 Feet
"B"	60"	1	1	0	1.42 Feet
"C"	72"	1	0	1	1.22 Feet
"D"	60"	1	0	1	1.98 Feet
"E"	48"	1	1	0	1.33 Feet
"F"	60"	1	0	1	4.14 Feet
"I"	60"	1	0	1	2.25 Feet
#1	72"	1	0	1	4.63 Feet

The pre-cast manhole sections are stored within two miles of the Water Treatment Plant and the contractor will be responsible for transporting this material to the construction site.

		Mechanical Clarifier
70	2	Drive Motors
71	1	Gear Reducer/Stand
72	1	Shaft Coupling
73	1	Extended Shaft
74	2	Torque Limiter
75	2	Pillow Block Bearings with Stand
76	2	Adjusto-Screw Tensioners
77	2	Drive Unit Chain
78	2	Drive Sprocket
79	8	Shafts
80	12	Wall Bearings
81	16	Chain Sprocket
82	4	Take Up Bearings
83	4	Drag Chain
84	23	Redwood Flights (Includes 25% Spare Parts)
85	4	Slide Rails
86	10	Collector Chain Links (Spare Part)
87	4	Chain Attachment Links (Spare Part)
88	1	Drive Chain (Spare Part)
89	4	Drive Links (Spare Part)
90	(50%)	Flight Wear Shoes with Hardware (Spare Part)

SITE MCAS (E) NEW RIVER AIR STATION

1	2	Submersible Pumps
2	2	Quick Disconnects
3	2	Pump Base and Ells
4	4	Pump Level Control Systems
5	1	Access Hatch and Frame
6	2	Guide Rails and Braces
7	1	Wiring Channel and Flexible Pump Cables
8	4	Dresser Coupling
9	2	3" Check Valve
10	2	3" Gate Valve
11	1	Electrical Control Panel *
12	50 LF	3" DIP
13	3	3" 90 Degree Ell Flanged
14	1	3" Flanged Tee
15	2	4"x 3" Flanged Reducer
16	6	3" Flanged and P.E. Pieces
17	25 LF	8" DIP
18	1	8" M.J. 90 Degree Bend
19	2	8" Wall Sleeves

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01011-6

SECTION 01012. ADDITIONAL GENERAL PARAGRAPHS

1. UTILITIES:

1.1 Government-Furnished Utilities: The Government will furnish water and electricity from the nearest available outlet free of charge for pursuance of work under this contract. If the nearest available outlet cannot be utilized by the Contractor because of improper voltage, insufficient current, improper pressure, incompatible connectors, etc., it shall be the responsibility of the Contractor to provide temporary utilities as required.

1.2 Energy and Utilities Conservation: The Contractor shall carefully conserve utilities furnished without charge. The Contractor, at his own expense and in a manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines and remove the same prior to final acceptance of the construction. (DAR 7-603.30)

1.3 Operation of Station Utilities: The Contractor shall not operate nor disturb the setting of any control devices in the Base utilities system, including water, sewer, electrical and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer, giving reasonable advance notice, when such operation is required.

1.4 Location of Underground Utilities: Where existing piping, utilities, and underground obstructions of any type are indicated in locations to be traversed by new piping, ducts, and other work provided hereunder, and are not indicated or specified to be removed, the elevations of the existing utilities and obstructions shall be determined before the new work is laid closer than the nearest manhole or other structure at which an adjustment in grade could be made. For any additional work required by reason of conflict between the new and existing work, an adjustment in contract price will be made in accordance with General Provisions clause entitled "Differing Site Conditions (1968 FEB)." The Base Telephone Officer, telephone 451-2531, will show the Contractor approximate locations of all buried telephone and fire alarm cables after receiving 10 days notice. The locations of underground utilities shown is only approximate and the information is incomplete.

2. CHANGED CONDITIONS: Wherever changed conditions as defined in General Provisions clause entitled "Differing Site Conditions (1968 FEB)" are encountered, and wherever conditions exposed during the course of the work necessitate a change from quantities indicated or specified as either estimated quantities or as a basis for bids, whether or not provisions for a change in price for such variation is specified, the Contracting Officer must be notified in writing and written directions to do so must be obtained before quantities stated in the contract documents are exceeded.

3. SUBCONTRACTORS AND PERSONNEL: Promptly after the award of the contract, the Contractor shall submit to the Contracting Officer, in triplicate, a list of his subcontractors and the work each is to perform. On this form shall appear the names of the key personnel of the Contractor and subcontractors, together with their home addresses and telephone numbers, for use in event of emergency. From time to time as changes occur and additional information becomes available, the Contractor shall amplify, correct, and change the information contained in previous lists.

4. PRINTS FURNISHED TO CONTRACTOR: Six copies of the project specifications, and six sets of the drawings accompanying the specifications, will be furnished the Contractor. Additional sets of the specifications and drawings can be obtained, if required, by application to the Contracting Officer, provided that the need therefor is justified to the satisfaction of the Contracting Officer.

5. SCHEDULE OF PRICES: The original and seven copies of the Schedule of Prices shall be submitted to the Contracting Officer for approval. Payments will not be made until the Schedule of Prices has been submitted and approved.

6. CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT: Requests for payment in accordance with the terms of the contract shall consist of:

- a. Contractor's Invoice on Form NAVFAC 10-7300/30(4/68), which shall show, in summary form, the basis for arriving at the amount of the invoice
- b. Contractor's Monthly Estimate for Voucher (5ND GEN 5265/1)
- c. Affidavit to Accompany Invoice (5ND LANTDIV 4-4235/4) (Rev 1/68)

Forms will be furnished by the Contracting Officer. Monthly invoices and supporting forms for work performed through the 15th of the month shall be submitted to the Contracting Officer by the 20th of the month in the following quantities:

- a. Contractor's Invoice - Original and five copies
- b. Contractor's Monthly Estimate for Voucher - Original and two copies
- c. Affidavit - Original

7. OPTIONAL REQUIREMENTS: Where a choice of materials or methods is permitted herein, the Contractor will be given the right to exercise the option unless stated specifically otherwise.

8. QUARANTINE FOR IMPORTED FIRE ANT (CLNC 2/82): All of Onslow, Jones and Carteret Counties and portions of Duplin and Craven Counties have been declared a generally infested area by the United States Department of Agriculture for the imported fire ant. Compliance with the quarantine regulations established by this authority as set forth in USDA Quarantine No. 81 dated 9 October 1970, and USDA Publication 301.81-2A of 23 July 1976, is required for operations hereunder

8.1 The quarantine applies to materials originating from Camp Lejeune and the Marine Corps Air Station (Helicopter), New River, which are to be transported outside the Onslow County or adjacent suppression areas.

8.2 Certification is required for the following articles, and they shall not be moved from the reservation to any point outside the Onslow County and adjacent designated areas unless accompanied by a valid inspection certificate issued by an officer of the Plant Protection and Quarantine Program, USDA:

(1) Bulk soil

(2) Used mechanized soil-moving equipment

(3) Any other products, articles, or means of conveyance if it is determined by an inspector that they present a hazard of spread of the imported fire ant and the person in possession thereof has been so notified.

8.3 Authorization for movement of equipment outside the imported fire ant regulated area shall be obtained from USDA, APHIS, PPQ, Rural Route 6, Box 53, Wilmington, NC 28504; telephone (919) 343-4667. Requests for inspection shall be made at least two days in advance of the date of movement to permit arrangements for the services of authorized inspectors. The equipment shall be prepared and assembled so that it may be readily inspected. All soil on or attached to equipment, supplies and materials shall be removed by washing with water and/or such other means as necessary to accomplish complete removal. Resulting spoil shall be wasted as directed.

9. EMERGENCY MEDICAL CARE: Only emergency medical care is available at Camp Lejeune Government facilities for Contractor employees who suffer on-the-job injury or disease. Emergency care will be rendered at the prevailing rates established in BUMEDINST 6320.4 series. Reimbursement shall be made by the Contractor to the Naval Regional Medical Center Collection Agent upon receipt of a monthly statement.

10. PROPRIETARY NAMES: Names indicated for colors, textures and patterns of materials are for the purpose of color, texture and pattern selection only. Other manufacturer's materials are acceptable provided they closely approximate colors, textures and patterns indicated and provided they conform to all other requirements.

11. NORTH CAROLINA STATE AND LOCAL SALES AND USE TAX (1977 JAN):

(a) As used throughout this clause, the term "materials" means building materials, supplies, fixtures and equipment which become a part of or are annexed to any building or structure erected, altered, or repaired under this contract.

(b) If this is a fixed-price contract as defined in the Defense Acquisition Regulation, the contract price includes the North Carolina state and local sales and use taxes to be paid with respect to materials, notwithstanding any other provision of this contract. If this is a cost-reimbursement type contract as defined in such regulation, any North Carolina state and local sales and use taxes paid by the Contractor with respect to materials shall constitute an allowable cost under this contract.

(c) At the time specified in paragraph (d) below:

(i) The Contractor shall furnish the Contracting Officer certified statements setting forth the cost of the materials purchased from each vendor and the amount of North Carolina state and local sales and use taxes paid thereon. In the event the Contractor makes several purchases from the same vendor, such certified statement shall indicate the invoice numbers, the

inclusive dates of the invoices, the total amount of the invoices and the North Carolina state and local sales and use taxes paid thereon by the Contractor. Any local sales or use taxes included in the Contractor's statements must be shown separately from the state sales or use tax. The Contractor shall furnish such additional information as the Commissioner of Revenue of the State of North Carolina may require to substantiate a refund claim for sales or use taxes.

(ii) The Contractor shall obtain and furnish to the Contracting Officer similar certified statements by its subcontractors.

(d) If this contract is completed before the next October 1, the certified statements to be furnished pursuant to paragraph (c) above shall be submitted within 60 days after completion. If this contract is not completed before the next October 1, such certified statements shall be submitted on or before the 30th day of November of each year and shall cover taxes paid during the twelve-month period which ended the preceding September 30.

(e) The certified statements to be furnished pursuant to paragraph (c) above shall be in the following form:

I hereby certify that during the period _____ to _____, (name of Contractor or subcontractor) paid North Carolina state and local sales and use taxes aggregating \$ _____ (state) and \$ _____ (local) with respect to building materials, supplies, fixtures and equipment which have become a part of or annexed to a building or structure erected, altered or repaired by (name of Contractor) for the United States of America, and that the vendors from whom the property was purchased, the dates and numbers of the invoices covering the purchases, the total amount of the invoices of each vendor, the North Carolina state and local sales and use taxes paid thereon, shown separately, and the cost of property withdrawn from warehouse stock and North Carolina state and local sales or use taxes paid thereon are as set forth in the attachments hereto.

12. AS-BUILT DRAWINGS: During the progress of the work, one full-size print of each of the drawings accompanying this specification shall be neatly and clearly marked in red to show all variations between the construction actually provided and that indicated or specified in the contract documents. The as-built drawings shall be kept up-to-date at the work site at all times during the contract, and shall be available for inspection by the Contracting Officer upon request. The Contractor shall also mark the drawings to indicate the exact location of any underground utility lines discovered in the course of the work. Where a choice of materials and/or methods is permitted herein, and where variations in the scope or character of the work indicated or specified are permitted either by award on bidding items specified for that purpose or by subsequent change to the contract, the as-built drawings shall define the construction actually provided. The representation of such variations shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as may be necessary for legibility and clear portrayal of the as-built construction; the marked prints shall be subject to approval of the Contracting Officer before acceptance. Upon completion of the work, the completed as-built drawings shall be presented to the Contracting Officer.

*** END OF SECTION ***

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01012 - 4

SECTION 01401. QUALITY CONTROL

1. APPLICABLE PUBLICATION: The following publication of the issue listed below, but referred to thereafter by basic designation only, forms a part of this specification to the extent indicated by the references thereto:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

ASTM E329-77 Standard Recommended Practices for Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

2. QUALITY CONTROL of this contract will be administered under the General Provisions Clause entitled "Contractor Inspection System".

3. DEFINITIONS:

3.1 Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.

3.2 Field Tests: Tests or analyses made at, or in the vicinity of, the job site in connection with the actual construction.

3.3 Product: The term "product" includes the plural thereof and means a type or a category of manufactured goods, construction, installations and natural and processed materials or those associated services whose characterization, classification or functional performance determination is specified by standards.

3.4 Person: The term "person" means associations, companies, corporations, educational institutions, firms, government agencies at the Federal, State and Local level, partnerships, and societies, as well as divisions thereof, and individuals.

3.5 Testing Laboratory: The term "testing laboratory" means any "person", as defined above, whose functions include testing, analyzing, or inspecting "products", as defined above, and/or evaluating the design or specifications of such "products" according to the requirements of applicable standards.

3.6 Certified Test Reports: Reports of tests signed by a qualified professional attesting that the test results reported are accurate and that items tested either meet or fail to meet the stated minimum requirements. These test reports include those performed by Factory Mutual, Underwriters' Laboratories, Inc., and others.

3.7 Certified Inspection Reports: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report.

3.8 Manufacturer's Certificate of Conformance or Compliance: A certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the specification requirements.

4. SUBMITTALS shall be prepared in accordance with this specification and the General Provisions and submitted to the Contracting Officer for approval. Each submittal shall be accompanied with a cover letter signed by the Contractor. Each item proposed to be incorporated into the contract shall be clearly marked and identified in the submittals, and shall be cross-referenced to the contract drawings and specifications so as to identify clearly the use for which it is intended. Each sheet of submittal shall be stamped with the Contractor's certification stamp. Data submitted in a bound volume or on one sheet printed on two sides, may be stamped on the front of the first sheet only. The Contractor's certification stamp shall be worded as follows:

"It is hereby certified that the (equipment)(materials) shown and marked in this submittal is that proposed to be incorporated into Contract Number _____, is in compliance with the contract drawings and specifications, can be installed in the allocated spaces, and is submitted for Government approval. Certified by _____
Date _____"

The person signing the certification shall be one designated in writing by the Contractor as having that authority. The signature shall be in original ink. Stamped signatures are not acceptable.

4.1 Submittal Status Logs: The Contractor shall maintain at the job site an up-to-date submittal status log showing the status of all submittals required by the contract. A sample format of an acceptable log is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample.

4.2 Samples, shop drawings, manufacturer's data, certifications and data required of the Contractor: Specification MIL-D-1000 shall be used as a guide and its use is encouraged, for all drawings and data submitted by the Contractor. Conformance to the provisions of Specification MIL-D-1000 is not mandatory for maps, sketches, presentation drawings, perspectives, renderings, and all other drawings not requiring Naval Facilities Engineering Command drawing numbers. Before starting the fabrication or installation of any of this work, the Contractor shall submit to the Contracting Officer for, and receive approval of, in accordance with the General Provisions, such drawings as may be required, including all items specified in the applicable paragraphs of the technical sections of this specification. Seven copies of all submittals to be approved by the Contracting Officer shall be forwarded.

4.3 Identification: All catalog cuts, shop drawings, samples and other data submitted for approval shall specifically identify the specification paragraph or contract drawing by number where each item submitted is required to be provided. All submittals shall be clearly marked in

ink to indicate the specific item(s) submitted for approval. Samples shall be clearly labeled with strong tags, firmly affixed, or indelible markings to identify the contract number, contractor, manufacturer, and item name.

4.4 Certified Test Reports: Before delivery of materials and equipment, four certified copies of the reports of all tests listed in the technical sections and referenced publications shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified herein. The tests shall have been performed within three years of submittal of the reports for approval. Test reports shall be accompanied by certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as that tested.

4.5 Manufacturer's Certificates of Conformance or Compliance: Manufacturer's certification furnished by the Contractor on items of materials and equipment incorporated into the work will be accepted only when this method will assure full compliance with the provisions of the contract, as determined by the Contracting Officer. Preprinted certifications will not be acceptable. All certifications shall be in the original. The original of all manufacturer's certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test reports upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance or compliance.

4.6 Laboratory Reports shall cite the contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by the representative of the testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

4.7 Tabulation of Tests: In addition to the General Provisions requirements for CQC test reports, prior to final payment the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract, including conforming or nonconforming, and repeated test results. The tabulation(s) shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.

5. QUALITY CONTROL REQUIREMENTS: In accordance with the General Provisions Clause entitled "Contractor Inspection System", the Contractor shall inspect and test all work under the contract and maintain records of the inspections and tests. Approvals, except those required for field

installations, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. Surveillance of the inspection system will be performed by the Contracting Officer.

5.1 Factory Tests: Unless otherwise specified, the Contractor will arrange for factory tests when they are required under the contract.

5.2 Factory Inspection: Unless otherwise specified, the Contractor will arrange for factory inspection when required under the contract.

5.3 Field Inspections and Tests by the Contractor: The Contractor shall furnish all equipment, instruments, qualified personnel, and facilities necessary to inspect all work and perform all tests required by the contract. All inspections and tests performed and test results received each day shall be included in the Daily Report to Inspector.

5.5 Approval of Testing Laboratories: All laboratory work under this contract shall be performed by a laboratory approved by the Government, whether the laboratory is employed by the Contractor, or is owned and operated by the Contractor. The basis of approval includes the following:

a. Testing laboratories performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E329, except that the Contracting Officer will perform the function of paragraphs 3.4 and 3.5 therein in the absence of other Government approval.

b. Testing laboratories performing work not in connection with concrete, steel, or bituminous materials shall comply with sections 3 and 4 of ASTM E329, except that the Contracting Officer will perform the functions of paragraphs 3.4 and 3.5 therein in the absence of other Government approval.

5.6 Repeated Tests and Inspections: The Contractor shall repeat tests and inspections after each correction made to nonconforming materials and workmanship until tests and inspections indicate the materials, equipment, and workmanship conform to the contract requirements. The retesting and reinspections shall be performed at no additional cost to the Government.

5.7 Daily Report to Inspector: The Daily Report to the Inspector Form NAVFAC 4330/34 shall be submitted to the Contracting Officer by 10:00 A.M. on the working day following the day the work was performed.

INSTRUCTIONS

1. This form may be used by the Contractor for listing all material submittals that require action by either the Contractor or the Government.
2. Columns (a) through (e) should be completed by the Contractor and must include all submissions that are required by the specifications.
3. As submittals are received and processed, the remaining columns are to be completed by the Contractor.
4. In those instances where the Contractor has approved the submittal under his contract responsibility, there may be a dual Action Code under column (f); e.g., "A/E", indicating approved as submitted and forwarded to the OICC for record purposes.
5. In column (f) for those items requiring OICC action (Action Code "D"), the reason for forwarding to the OICC should be entered in the column (1), the Remarks column; e.g., gov't approval required; waiver requested because of variance, substitution, etc.
6. Where no Government action is required, (for Contractor review/approval items), there need be no entry in columns (h) and (i).
7. Column (j) is completed when material or equipment is delivered to the project. Column (k) is completed only after verification that the delivered item is that represented by the approved submittal.

ACTION CODE: To be used when completing columns (f) and (h)

- A - Approved as submitted
- B - Approved as noted
- C - Disapproved
- D - Forwarded to OICC for action
- E - Forwarded to OICC for record purposes

END OF SECTION

SECTION 01560

ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 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.

ENVIRONMENTAL PROTECTION AGENCY (EPA):

40 CFR 61(Subpart B) National Emission Standards for Asbestos (1979)

40 CFR 761 Polychlorinated Biphenyls (1979)

U. S. DEPARTMENT OF LABOR OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION (OSHA):

29 CFR 1910.1001 General Industry Safety and Health Standards (1979)

FEDERAL REGULATION (FR):

Executive Order 11988 Flood Plain Management (42 FR 28951)

NAVAL ENVIRONMENTAL PROTECTION SUPPORT SERVICE (NEPSS):

PS-015 Disposal of Lead-Acid Battery Electrolyte,
April 18, 1980

1.2 DEFINITIONS OF CONTAMINANTS:

1.2.1 Sediment: Soil and other debris that has been eroded and transported by runoff water.

1.2.2 Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations, and from community activities.

1.2.2.1 Rubbish: A variety of combustible and noncombustible wastes such as paper, boxes, glass, crockery, metal, lumber, cans, and bones.

1.2.2.2 Debris: Includes combustible and noncombustible wastes, such as ashes, waste materials that result from construction or maintenance and repair work, leaves, and tree trimmings.

1.2.3 Chemical Wastes: Includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

1.2.4 Sanitary Wastes:

1.2.4.1 Sewage: Wastes characterized as domestic sanitary sewage.

1.2.4.2 Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.5 Asbestos and Asbestos Materials: Asbestos means actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite. Asbestos material means asbestos or any material containing asbestos such as asbestos waste, scrap, debris bags, containers, equipment, and asbestos-contaminated clothing consigned for disposal. Friable asbestos material means any material that contains more than one percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder, when dry, by hand pressure.

1.2.6 Oily Waste: Includes petroleum products and bituminous materials.

1.3 SUBMITTALS:

1.3.1 Environmental Protection Plan: Submit four copies of the proposed Environmental Protection Plan not later than 14 days after the meeting with the Contracting Officer to discuss the development of an Environmental Protection Plan.

1.3.2 Notices Pertinent to Asbestos Removal:

1.3.2.1 Notice to EPA: Submit three copies of the notice of intention to demolish asbestos insulated or fireproofed materials and equipment provided to the Administrator of EPA, and the State's Environmental Protection Agency as required in paragraph titled "Written Notice."

1.3.2.2 Preconstruction Survey Report: Submit three copies of the preconstruction survey report.

1.3.3 Solid Waste Disposal Permit: Submit one copy of State and local permit or license which reflects such agency's approval of the disposal plan as being in compliance with their solid waste disposal regulations.

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS: Provide and maintain during the life of the contract, environment protection as defined herein. Provide environmental protective measures as required to control pollution that develops during normal construction practice. Provide also environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all federal, state, and local regulations pertaining to water, air, and noise pollution. Develop proposals for an environmental protection plan for the project and, prior to the commencement of the work, meet with the Contracting Officer and discuss the proposed environmental protection plan. The meeting shall develop mutual understanding relative to details of environmental protection, including measures for protecting natural resources, required reports, and measures to be taken should the Contractor fail to provide adequate protection in an adequate and timely manner. Perform a preconstruction survey of the project site and take photographs as necessary to enhance the survey.

PART 2 - EXECUTION

2.1 PROTECTION OF NATURAL RESOURCES: The natural resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their existing condition or restored to an equivalent or improved condition upon completion of the work. Confine construction activities to areas defined by the work schedule, drawings, and specification.

2.1.1 Land Resources: Except in areas indicated to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without special permission from the Contracting Officer. Do not fasten or attach ropes, cables, or guys to any existing nearby trees for anchorages unless specifically authorized. Where such special emergency use is authorized, the Contractor shall be responsible for any resultant damage.

2.1.1.1 Protection: Protect existing trees which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. Protect monuments, markers, and works of art.

2.1.1.2 Repair or Restoration: Repair or restore to their original condition all trees or other landscape features scarred or damaged by the equipment or operations. Obtain approval of the repair or restoration from the Contracting Officer prior to its initiation. Include topsoil or nutriment during the seeding operation as necessary to provide a suitable stand of grass.

2.1.2 Water Resources: Perform all work in such a manner that any adverse environmental impact on water resources is reduced to a level acceptable to the Contracting Officer.

2.1.2.1 Stream Crossings: Limit equipment fording across stream to control turbidity.

2.1.2.2 Oily Substances: Take special measures to prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Surround all temporary fuel oil, petroleum, or liquid chemical storage tanks with a temporary earth berm of sufficient size and strength to contain the contents of the tanks in the event of content leakage or spillage.

2.1.3 Fish and Wildlife Resources: During the performance of the work take such steps as required to prevent interference or disturbance to fish and wildlife. Do not alter water flows or otherwise significantly disturb native habitat adjacent to the project area which are critical to fish and wildlife except as may be indicated or specified.

2.1.4 Historical and Archeological Resources: Carefully preserve and report immediately to the Contracting Officer all items having any apparent historical or archeological interest which are discovered in the course of any construction activities.

2.2 EROSION AND SEDIMENT CONTROL MEASURES:

2.2.1 Burn-off: Burn-off of ground cover is not permitted.

2.2.2 Borrow Pit Areas: Manage and control borrow pit areas to prevent sediment from entering nearby streams or lakes. Restore areas, including those outside borrow pit, disturbed by borrow and haul operations. Restoration includes grading, replacement of topsoil, and establishment of permanent vegetative cover. Uniformly grade side slopes of borrow pit to a slope of 30 degrees or less with the horizontal. Uniformly grade bottom of borrow pits to provide a flat bottom and drain by outfall ditches or other suitable means. Borrow locations will be as directed by the Contracting Officer.

2.2.3 Protection of Erodible Soils: All earthwork brought to final grade shall be immediately finished as indicated or specified. Protect immediately side slopes and back slopes upon completion of rough grading. Plan and conduct all earthwork in such a manner as to minimize the duration of exposure of unprotected soils.

2.2.4 Temporary Protection of Erodible Soils: Utilize the following methods to prevent erosion and control sedimentation.

2.2.4.1 Mechanical Retardation and Control of Runoff: Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, and berms, to retard and divert runoff to protected drainage courses.

2.2.4.2 Sediment Basins: Trap sediment in temporary or permanent sediment basins. Select basin size to accommodate the runoff of a local 50 year storm. Pump dry and remove accumulated sediment after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs as required by state and local environmental agencies.

2.2.4.3 Vegetation and Mulch: Provide temporary protection on all side and back slopes as soon as rough grading is completed or sufficient soil is exposed to require protection to prevent erosion. Such protection shall be accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

2.3 CONTROL AND DISPOSAL OF SOLID, CHEMICAL, AND SANITARY WASTES: Pick up solid wastes and place in containers which are emptied on a regular schedule. The preparation, cooking, and disposing of food are strictly prohibited on the project site. Conduct handling and disposal of wastes to prevent contamination of the site and other areas. On completion, leave areas clean and natural looking. Obliterate signs of temporary construction and activities incidental to construction of the permanent work in place. The Base Sanitary Landfill will not accept liquid wastes or empty drums. If transporting any material off Government property, the Contractor shall provide the Contracting Officer a copy of state and/or local permit which reflects the responsible agency's approval of the disposal area and proposed waste disposal methods.

2.3.1 Disposal of Garbage, Rubbish and Debris: Remove garbage, rubbish and debris from Government property and dispose of it in compliance with federal, state and local requirements.

2.3.2 Sewage, Odor, and Pest Control: Dispose of sewage through connection to station sanitary sewage system. Where such systems are not available, use chemical toilets or comparably effective units and periodically empty wastes into municipal or station sanitary sewage system. Include provisions for pest control and elimination of odors.

2.3.3 Chemical Waste: Store chemical waste in corrosion resistant containers labeled to identify type of waste and date filled. Remove containers from the project site, and dispose of chemical waste in accordance with federal, state, and local regulations. For oil and hazardous material spills which may be large enough to violate federal, state, and local regulations, notify the Contracting Officer immediately.

2.3.3.1 Petroleum Products: Conduct fueling and lubricating of equipment and motor vehicles in a manner that affords the maximum protection against spills and evaporation. Dispose of lubricants to be discarded and excess oil in accordance with approved procedures meeting federal, state and local regulations.

2.3.3.2 Polychlorinated Biphenyls (PCB) Control: Comply with 40 CFR 761 for removal and disposal of PCB containing articles.

2.3.3.3 Lead-Acid Battery Electrolyte: Electrolyte solution from lead-acid batteries shall be disposed of in such a manner as to ensure compliance with applicable federal, state, and local regulations. The electrolyte shall not be dumped onto the ground, into storm drains or into the sanitary sewer without neutralization. One of the following alternatives shall be used for disposal of waste electrolytes.

a. An industrial waste treatment plant, if available and approved for neutralizing and disposing of battery-acid electrolyte.

b. Transport the electrolyte to a state-approved hazardous waste disposal site. Method of transportation and equipment must comply with applicable federal and state regulations.

2.3.4 Asbestos: Comply with 29 CFR 1910.1001, 40 CFR 61, and the requirements specified herein for the disposal of material containing asbestos and demolition of materials and equipment insulated or fireproofed with friable asbestos material. Use of the Base Sanitary Landfill will be mandatory for all removal involving friable asbestos fiber.

2.3.4.1 Written Notice: Provide written notice of intention to demolish to the Administrator of EPA and the State's environmental protection agency at least 20 days prior to commencement of such demolition. Prepare reports in accordance with Section 61.22 of 40 CFR 61 and forward to EPA. The notice shall contain the following information:

- a. Name of Prime Contractor
- b. Address of Prime Contractor
- c. Address or location and description of buildings, structures, or facilities to be demolished or renovated, including size, age, prior use, and approximate amount of friable asbestos materials to be removed
- d. Schedule indicating planned start and completion of demolition or renovation
- e. Method of removal to be employed
- f. Procedures to be employed to meet the requirements of Sections 61.22(d) and 61.22(j) of 40 CFR 61, and Volume 1 of 29 CFR 1910.1001.
- g. The address or location of the waste disposal site for the friable asbestos wasted which will be the Camp Lejeune Base Sanitary Landfill.

2.3.4.2 Use the following procedures and those required by Section 61.22 of 40 CFR 61 to prevent emissions of particulate asbestos material to outside air:

a. Unless otherwise specified, wet all friable asbestos materials before removal from any building, structure, facility, or installation. Pipe, structural members, equipment, or other items insulated or fireproofed with friable asbestos materials may be removed as units or in sections without stripping. If pipes or structural members are cut or disjointed, wet all exposed friable asbestos materials. Wet all friable asbestos debris adequately to ensure that it remains wet during all stages of demolition and removal operations.

b. Do not drop or throw to ground any pipe, structural member, equipment, or item covered with friable asbestos insulation or fireproofing material. Carefully lower all asbestos and asbestos covered materials to ground level.

2.3.5 Rubble such as masonry, stone, concrete without reinforcing steel, and brick may be deposited as directed on the Base. Upon completion, the work and disposal area shall be left clean and natural looking. All signs of temporary construction and activities incidental to construction of the required permanent work in place shall be obliterated.

2.3.6 Optional use of Base Landfill shall require compliance with Landfill rules. Such rules do not allow accepting recyclable metals nor reusable wood or lumber over six feet in length.

2.4 DUST CONTROL: Keep dust down at all times, including non-working hours, weekends, and holidays. Sprinkle or treat, with dust suppressors, the soil at the site, haul roads, and other areas disturbed by operations. No dry power brooming is permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing is permitted only for cleaning nonparticulate debris, such as steel reinforcing bars. No sandblasting is permitted unless dust therefrom is confined. Only wet cutting of concrete blocks, concrete, and asphalt is permitted. No unnecessary shaking of bags is permitted where bagged cement, concrete mortar, and plaster is used.

2.5 NOISE: When available, make the maximum use of "low-noise-emission products" as certified by EPA. No blasting or use of explosives is permitted without written permission of the Contracting Officer and then only during the designated times. Confine pile driving operations to the period between 8 a.m. and 4 p.m., Monday through Friday, unless specified otherwise.

END OF SECTION

SECTION 02110. DEMOLITION

1. QUALITY CONTROL: Unless otherwise specified herein, requirements for supervision, inspection, sampling, testing, approval, directing, authorizing, and other requirements of similar import shall be the responsibility of the Contractor Quality Control representative.

2. SUBMITTALS:

2.1 Procedures: The procedures proposed for the accomplishment of salvage and demolition work shall be approved by the Contractor Quality Control representative and submitted to the Contracting Officer for record purposes before work is started. The procedures shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

3. REQUIREMENTS: The work includes the demolition or removal of all construction indicated, specified, or necessary to accomplish the work under this contract. The work indicated or specified in this section or other sections of the specifications is included, but is not intended that all items of demolition work be specifically indicated, specified, or listed. After carefully reviewing the drawings and specifications to determine intent, the Contractor shall visit the site and determine the extent of demolition work required to properly complete the work under this contract.

3.1 Demolition and removal shall be conducted in a manner that will eliminate hazards to persons and property in the area and shall prevent the release of dust and rubbish into the air. All debris resulting from demolition or removal work shall be removed from the station daily or as directed by the Contracting Officer. Trash and rubbish shall not be allowed to accumulate either within or outside the buildings. Demolished materials and debris which in the opinion of the Contracting Officer cannot practicably be removed from the site the same day as removed, may be temporarily stacked or stored in a designated location on the site as directed by the Contracting Officer. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in section: ENVIRONMENTAL PROTECTION.

3.2 Dust Control: The amount of dust resulting from demolition shall be controlled to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

3.3 Protection of Existing Work: Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing work and examine the drawings and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Government and any damage to such work shall be repaired or replaced, as approved by the Contracting Officer, at no additional cost to the Government. The Contractor shall carefully coordinate the work of this section with all work and construct and maintain shoring, bracing and supports, as required. He shall insure that structural elements are not overloaded and be responsible for increasing structural supports or adding new supports or reinforcing as may be required as a result of any cutting, removal, or demolition work performed under any part of this contract.

3.4 Use of Explosive: Use of explosives will not be permitted.

3.5 Filling: Holes, open basements and other hazardous openings shall be filled as specified in Section entitled: EARTHWORK.

3.6 Structures, Walls and Partitions : Existing structures indicated shall be removed two feet below grade.

3.7 Removal of masonry shall be accomplished so as to prevent damage to existing surfaces of units remaining in exposed locations and to facilitate the installation of new work. Where new masonry adjoins existing units, the new work shall abut or be toothed into the existing construction as necessary to maintain the existing bond and surface pattern.

3.8 Removal of concrete: Where existing concrete work is to be removed, the concrete shall be sawn along straight lines to a depth of not less than 2 inches. Each cut in walls shall be perpendicular to the face and in alignment with the cut in the opposite face. The remainder of the concrete shall be broken out, provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, it shall be ground smooth or the saw cut shall be made entirely through the concrete.

3.9 Pavement removal and replacement is specified in section entitled "Pavement Removal and Replacement".

3.10 Utilities: Remove all existing utilities, as indicated, and terminate in a manner and at a time satisfactory to the Government. Meters and related equipment shall be removed and delivered to a location as directed by the Contracting Officer without additional cost to the Government. When utility lines are encountered that are not indicated on the drawings, they shall be disposed of as directed by the Contracting Officer and disposal shall be covered by Differing Site Conditions in accordance with the General Provisions.

SECTION 02200. EARTHWORK

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

1.1 Military Standards:

MIL-STD-619B Unified Soil Classification System for Roads, Airfields, Embankments and Foundations.

1.2 American Society for Testing and Materials (ASTM) Publications:

C136-71 Test for Sieve Analysis of Fine and Coarse Aggregates.
D423-66(1972) Test for Liquid Limit of Soils.
D424-59(1971) Test for Plastic Limit and Plasticity Index of Soils.
D698-70 Moisture-Density Relationship of Soils Using 5.5-lb. (2.5kg) Rammer and 12-in (304.8mm) Drop.
D1140-54(1971) Amount of Material in Soils Finer than the No. 200 Sieve.
D1556-64(1974) Density of Soil in Place by the Sand-Cone Method.
D2922-71 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 American Water Works Association (AWWA) Publications:

D203-66 Coal-tar Enamel Protective Coatings for Steel Water Pipe.
C600-66 Installation of Cast Iron Water Mains.

1.4 North Carolina Department of Transportation and Highway Safety (NCDOT):

"Standard Specifications for Roads and Structures", dated July 1, 1978

2. QUALITY CONTROL: Approvals, except those required for field installations, field applications, and field tests, shall be obtained before delivery of materials or equipment to the project site.

3. SUBMITTALS:

3.1 Certified Laboratory Test Reports: Before delivery of materials, certified copies of the reports of all tests required herein under materials and in referenced publications shall be approved by the Contractor Quality Control representative and submitted to the Contracting Officer for record purposes. The testing shall have been performed in an independent laboratory approved by the Contracting Officer. Additional testing

shall be submitted when the source of materials is changed. Certified test reports are required for the following:

- (1) Capillary water barrier
- (2) Fill for drains
- (3) Bedding material
- (4) Fill and backfill

3.2 Dewatering Plan: See requirements for dewatering in paragraph 9.1.1.

4. DELIVERY AND STORAGE: Materials shall be delivered and stored in a manner to prevent contamination and segregation.

5. GENERAL REQUIREMENTS: Bids shall be based on the following:

- (1) That the surface elevations are as indicated.
- (2) That no pipes or other artificial obstructions, except those indicated, will be encountered.
- (3) That hard material will not be encountered. Blasting will not be permitted.
- (4) That ground water elevations indicated are those existing at the time subsurface investigations were made and do not necessarily represent permanent ground water elevation.

In case the actual conditions differ substantially from those stated or shown, the provisions of the contract respecting an adjustment for changed conditions shall apply, subject to the requirements of notification thereunder being given. Hard material shall be defined as solid rock, firmly cemented unstratified masses or conglomerate deposits possessing the characteristics of solid rock not ordinarily removed without systematic drilling and blasting, and any boulder, masonry, or concrete except pavement, exceeding one-half cubic yard in volume.

6. ENVIRONMENTAL PROTECTION: All work and Contractor operations shall comply with the requirements of Section: ENVIRONMENTAL PROTECTION.

7. MATERIALS:

7.1 Granular Fill:

7.1.1 Capillary water barrier (indicated as porous fill) under concrete floor slabs and areaways shall consist of clean crushed stone, crushed gravel, or uncrushed gravel, 90-100 percent passing a 3/4-inch sieve and 0-5 percent passing a No. 4 sieve with a sand equivalent of not less than 50. The capillary water barrier shall be placed directly on the subgrade. The barrier shall be constructed in layers not exceeding 4 inches in compacted thickness, and each layer shall be compacted with a minimum of two passes of a hand-operated plate type vibratory compactor.

7.1.2 Unless noted or specified otherwise, crushed stone fill under concrete slabs and structures shall conform to NCDOT "Standard Specifications for Roads and Structures", Size 5, Section 905. A minimum of 12 inch crushed stone shall be provided under concrete structures.

7.1.3 Select bedding shall be provided for all buried gravity flow lines, and on pressure piping where indicated. Bedding material shall be gravel, size NCDOT, Number 78.

7.1.4 Crusher run where indicated on the drawings shall conform to NCDOT "Standard Specifications for Roads and Structures", Size 7, Sections 905 and 910.

7.1.5 Fill for subsurface drains shall consist of clean stone or gravel and shall conform to the following requirements.

7.1.5.1 Perforated Wall Pipe: Fill shall meet the requirements of Type I material (indicated below), shall be placed as the pipe is laid, and shall extend for a minimum of one pipe diameter each side of and 18 inches above the pipe.

Sieve Size	Type I Percent Passing
1-1/2 inches	---
1 inch	---
3/8-inch	100
No. 4	95 - 100
No. 8	---
No. 16	45 - 80
No. 50	10 - 30
No. 100	0 - 10

7.2 Soil Materials:

7.2.1 Soil materials used as backfill for trenches, drains and for structures shall consist of native materials which are free from debris, roots, wood, scrap materials, and other vegetable matter and refuse.

7.2.2 Soil materials used as fill for embankments, under spread footings, and concrete slabs on grade which are not pile supported shall consist of materials conforming to the following: liquid limit shall not exceed 40 when tested in accordance with ASTM D423; plasticity index shall not be greater than 10 when tested in accordance with ASTM D424; no more than 25 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D1140. Materials classified as PT, OH, OL, CH, CL and ML by MIL-STD-619 shall not be permitted.

7.2.3 Topsoil which is to be stripped and stockpiled shall be free of subsoil, refuse, stumps, rocks over one-inch, brush, weeds and other materials detrimental to plant growth.

7.3 Filter fabric: The filter material shall be a synthetic, non-woven material, uniformly strong in all directions and resistant to rot, mildew, mild acids and alkalis and vermin. It shall be a non-clogging, porous material with high permeability and filtration characteristics.

(a) For silt fence construction, the filter fabric must be resistant to ultraviolet rays and retain its basic characteristics for a minimum of 6 months.

7.4 Woven Wire Fence: Wire shall be a minimum of 36 inches in width and shall have a minimum of six horizontal line wires (maximum 8 inch spacing) with 12 inch vertical (stay) spacing. The top and bottom horizontal strands shall be minimum #10 gauge and the remaining horizontal strands and the vertical stays shall be minimum #12½ gauge. All woven wire fence shall be hot dipped galvanized or electroplate galvanized in accordance with ASTM A-164 Type GS.

7.5 Erosion Control Stone: Erosion Control Stone (Rip Rap) shall conform to Section 942-1, Class 1 of the North Carolina Department of Transportation and Highway Safety "Standard Specifications for Roads and Structures" dated July 1, 1978. It shall be constructed in accordance with the details shown on the drawings.

(a) Type A Treatment: The stone shall be dumped or otherwise placed in such a manner as to present an irregular or rough surface. The depth of Type A Treatment shall be not less than 18 inches.

(b) Type B Treatment: The stone shall be dumped or otherwise placed in such a manner as to present an irregular or rough surface. The depth of Type B shall be not less than 18 inches. The top 6 inches shall be grouted and the portion below the top 6 inches may be choked with fine material.

7.6 Matting for Erosion Control: All matting shall conform to Section 885, Matting for Erosion Control, of the North Carolina Department of Transportation "Standard Specifications for Roads and Structures" dated July 1, 1978.

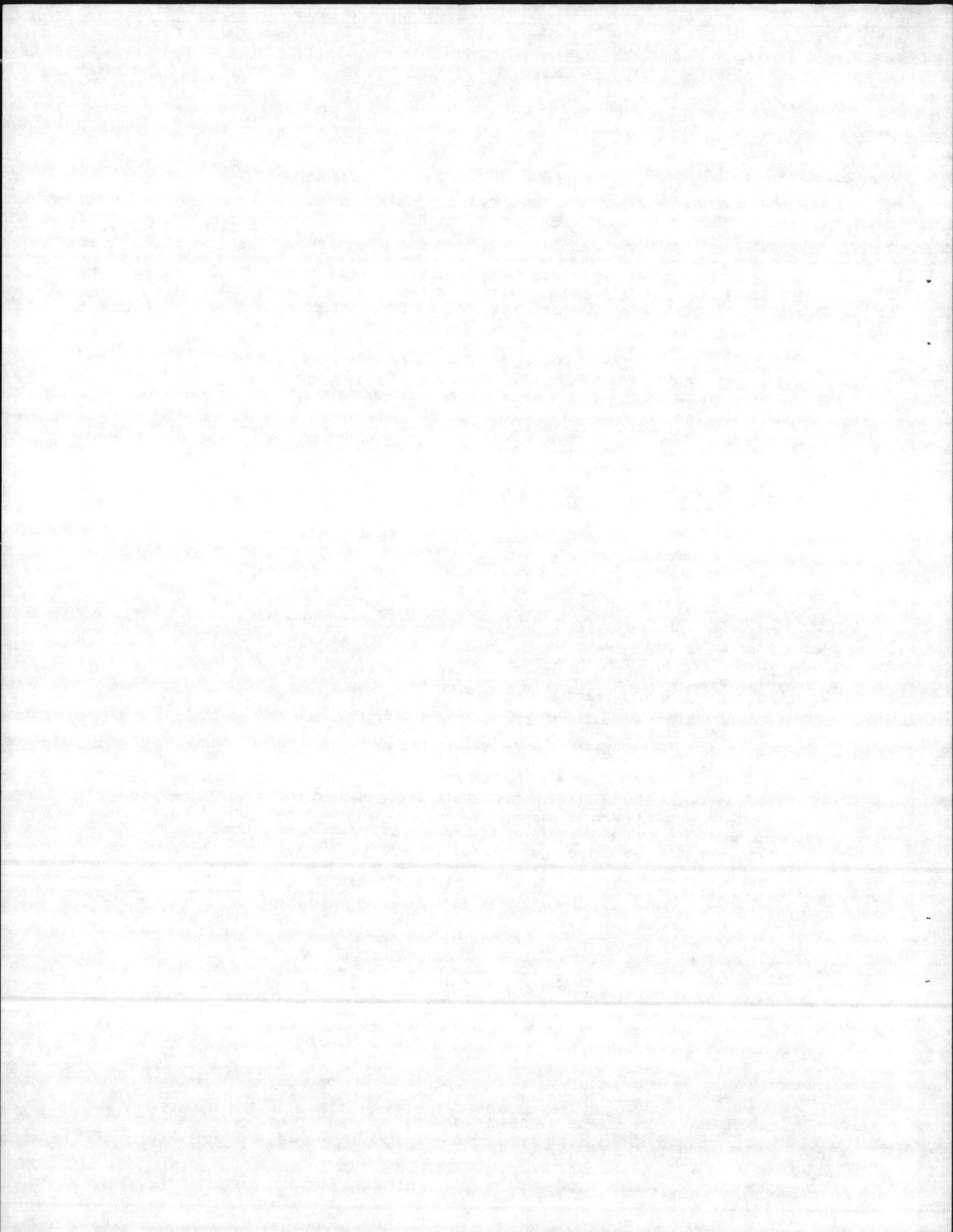
7.7 Straw Bales: Straw bales shall be grain straw or dry hay tightly bound with wire or nylon string.

8. REQUIREMENTS:

8.1 Clearing: All trees, logs, shrubs, and brush within the indicated clearing limits shall be removed except as indicated otherwise. Trees and shrubs which are not to be cut shall be protected properly from damage. All merchantable timber shall be cut into logs and stored on the site where directed by the Contracting Officer. Stumps shall be removed entirely. Roots and matted roots shall be grubbed out to at least 18 inches below the existing surface. Brush, refuse, stumps, roots, and unmerchantable timber shall be disposed of at the Base Sanitary Landfill.

8.2 Topsoil: Existing topsoil shall be stripped to a depth of 4 inches, stockpiled separately from other excavated materials, and shall be reused for finished surface grading. Topsoil shall be free of stones, wood matter, cuttings, excessive quantities of vegetation, and debris of every kind. Piles of topsoil shall be located so that the material can be used readily for finished surface grading; topsoil shall be protected and maintained until needed. The top 4-inch thickness of all newly graded earth surfaced areas shall consist of topsoil. Topsoil required in excess of that available from excavations and grading shall be provided by the Contractor from sources outside the station, and shall conform to the requirements for topsoil in the section entitled "Establishing Vegetation". Any surplus of topsoil from excavations and grading shall be stockpiled on the station at a location within 5,000 feet of the site of the work, as directed by the Contracting Officer. If there is insufficient topsoil available to form the 4-inch thickness, that available shall be utilized as directed. The Contractor will not be required to haul in additional topsoil if all requirements specified are complied with. Placing of topsoil is specified in the section entitled "Establishing Vegetation".

8.3 Excavations: Excavations shall be carried to the contours and dimensions indicated or necessary. Excavations shall be kept free from water while construction therein is in progress. In the event that it is necessary to remove soft or weak soil to a depth greater than indicated, the Contracting Officer shall be notified and an adjustment in the contract price will be considered in accordance with the contract. Excavations carried below the depths indicated, without specific directions from the Contracting Officer, shall, except as otherwise specified, be refilled to the proper grade with granular material and compacted to at least 95-percent of ASTM D698 density. All additional work of this nature shall be at the Contractor's expense. Soil disturbed and weakened by the Contractor's operations, or soils permitted to soften from exposure to weather shall be excavated and replaced with granular material compacted to 95 percent of ASTM D698 density. All additional work of this nature shall be at the Contractor's expense.



8.3.1 Excavations for Structures: In excavations for spread footings carried below the depths indicated without specific directions from the Contracting Officer, the concrete shall be extended to the bottom of the excavations; all additional work of this nature shall be at the Contractor's expense.

8.3.2 Excavation of Pipe Trenches: (Excavation shall be to grade as set forth in AWWA C600, unless otherwise directed in the event of poor soil. Width of trench shall be as shown on the Standard Pipe Trench Bedding details accompanying this section. Compaction of soil in the backfilling operation shall be as specified herein.

8.3.3 Excavations for Embankments and Under New Pavements and Concrete Slabs: The original ground under embankments less than 4 feet in thickness and under new pavements and concrete slabs shall be excavated to remove vegetable matter, sod, topsoil, muck, and rubbish to a minimum depth of 6 inches and to remove any weak soil disturbed by the Contractor's operations or softened by exposure to the elements and water. In the event that the Contractor is directed by the Contracting Officer to remove such unsuitable material to a greater depth than specified, an adjustment in the contract price or time for completion, or both, will be made in accordance with the contract. On slopes, the area under the embankment shall be scarified, after removal of such unsuitable material, and the first layer of embankment fill shall be keyed by scarifying securely to the existing material.

8.3.4 Shoring and Sheet piling: Excavations shall be shored and sheeted with members of sizes and arrangement sufficient to prevent injury to persons, damage to structure, injurious caving, or erosion. Shoring, sheet piling, and bracing shall be removed as the excavations are backfilled; care shall be exercised to prevent injurious caving during the removal of the shoring and/or sheet piling.

8.4 Borrow materials shall be obtained from the station borrow pit or from sources outside the station, at the Contractor's option. The station borrow pit is located within a haul distance of 5 miles from the site of the work. If the station borrow pit is used, the Contractor, at his expense, shall perform any clearing, grubbing, and stripping required for providing access to suitable borrow material and shall dispose of materials from clearing and grubbing operations off the station. The Contractor, at his expense, shall also remove and stockpile the top 12 inches of soil material in the area in which he is to get the borrow. After the borrow material has been removed, the borrow pit shall be trimmed neatly and graded to drain properly and the stockpiled soil material replaced and leveled over the borrow area. If the borrow materials are provided from sources outside the station, they shall be at the Contractor's expense.

8.5 Filling and Backfilling:

8.5.1 Backfilling for Structures and Trenches: Backfill shall be placed in layers not more than 12 inches thick, and each layer shall be compacted to at least 95 percent of ASTM D698 density. Backfill adjacent to structural elements shall be placed, as far as practicable, as the adjacent structural elements have been completed and accepted. Backfilling against concrete shall be done only when approved by the Contractor Quality Control representative. Backfilling of trenches shall progress as rapidly as the construction, testing, and acceptance of the work permits. Except as specified otherwise elsewhere in this specification, in backfilling pipe trenches, fill shall be compacted in 6-inch layers to a depth of one foot over the top of the pipe; the remainder of the trench shall be backfilled and compacted as specified under compaction. For trenches excavated in roads and streets, the backfill shall be placed and compacted in 6-inch layers to the top of the trench.

8.5.2 Fill for embankments, under spread footings, and for concrete slabs on grade which are not pile supported shall be placed in lifts no greater than 6 inches and each lift shall be compacted as specified herein, before the overlaying lift is placed. In all areas not accessible to rollers or compactors, the fill shall be compacted with mechanical hand tampers. If the mixture is excessively moistened by rain, it shall be aerated by means of blade graders, or harrows until the moisture content of the mixture is satisfactory. The surface of the layer shall be finished by blading or rolling with a smooth roller, or a combination thereof, and shall be smooth and free from waves and inequalities.

8.6 Compaction:

8.6.1 For other than primary roads and airfield pavement, the subgrade of soils in cut shall have a density of at least 95 percent of the maximum density in accordance with the requirements of ASTM D698 to a depth of 12 inches below the subgrade surface. If the density of the existing material is less than 95 percent, it shall be compacted to a depth of 12 inches to the minimum 95 percent density. Fill, embankment, and/or backfill under concrete floor slabs and under paved areas shall be compacted to not less than 95 percent of the maximum density; other backfill adjacent to and not supporting any structural elements to at least 90 percent. The upper 12 inches of trenches shall be compacted to at least 95 percent of ASTM D698.

8.7 Grading: The Contractor shall perform all grading in the areas so indicated. Fill shall be brought to finished grades indicated within of one-tenth of a foot and shall be graded to drain water away from structures. Existing grades which are to remain and which are disturbed by the Contractor's operations shall be graded to provide surfaces suitable for the proper use of mowing machines. Grades under areas to receive topsoil shall be brought to acceptable elevation.

8.8 Disposition of Surplus Material: Surplus material not required for filling, backfilling, or grading and other soil material shall be wasted to the Base Sanitary Landfill.

9. DEWATERING:

9.1 Dewatering During Construction: Dewatering shall include the control of all forms of surface and subsurface water that may be encountered in the course of construction.

9.1.1 The Contractor shall familiarize himself with site conditions, surface and subsurface, together with all available soil and hydrological data and, based on this information, together with the dewatering requirements as hereinafter specified, shall prepare a complete dewatering plan describing the basic components of the dewatering system he proposes to use for the work. The dewatering plan shall be submitted to the Contracting Officer for approval. Approval of this dewatering plan will only be with respect to the basic principals and methods that the Contractor intends to employ. Acceptance of the dewatering system will be based on demonstrated performance of the requirements contained herein.

9.1.2 All excavation, construction and backfilling shall be performed under workably dry conditions.

9.1.3 The dewatering system shall be operated until such time as all construction work below normal water level is complete.

9.1.4 The selection of size and spacing and type of dewatering equipment shall be the responsibility of the Contractor, and shall be approved by the Contractor Quality Control representative.

9.1.5 Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Contractor Quality Control representative shall order immediate shut-down and remedial measures will be the responsibility of the Contractor.

9.1.6 Upon completion of the dewatering work the Contractor shall remove all equipment and leave the construction area in a neat, clean and acceptable condition.

9.2 Dewatering at Site VII-9. Because of the criticality of the effect of groundwater drawdown on the raw water reservoir located adjacent to Site VII-9, the Contractor shall monitor the level of groundwater at various elevations by two systems of nested piezometers. The type of piezometer construction and the elevations of installation are shown on the drawings. Further, reference points where indicated shall be established prior to construction on the top of the reservoir and a log of their elevations shall be recorded over the construction period. Each piezometer and each reference point shall be monitored and recorded

daily for 10 days prior to construction, and at least once each day during construction. The obtained readings shall be immediately relayed to the Contracting Officer for evaluation and comment. Should the readings indicate a total settlement across the width of the tank greater than one-quarter inch, the Contractor shall cease construction at the site and await further directions from the Contracting Officer.

9.2.1 The method of piezometer installation shall be as follows: The section of borehole which will accept the piezometer tube shall be flushed with clear water. An assembly of 1-1/4 inch schedule 40 polyvinyl chloride (P.V.C.) pipe, with a slotted section at the base shall then be inserted into the hole. Uniform one-fourth inch gravel shall then be placed in the annular space between pipe and the walls of the hole; through the interval to be monitored. A lift of bentonite piezometer pellets shall be compacted on top of the gravel to seal the hole and a grout plug fixed above the pellets. The remainder of the annular space shall be backfilled with native soils to original grade.

Water used to flush the boring shall be withdrawn from the piezometer tube with a small hand pump. A vented and threaded cap completes the installation.

9.3 Dewatering Performance: Performance of the dewatering system shall be measured by suitable observation wells or piezometers installed in conjunction with the dewatering system and these are to be read at least daily. The Contractor Quality Control representative shall maintain a log of these readings and submit them to the Contracting Officer.

10. FIELD SAMPLING AND TESTING:

10.1 Sampling: All sampling shall be conducted by the Contractor at his expense.

10.2 Sample Identification: Each sample shall be contained in a clean container which shall be securely fastened to prevent loss of material. Each sample shall be tagged for identification. The tag shall contain the following information.

Contract No. _____ .
Sample No. _____ .
Date of Sample _____ .
Sampler _____ .
Source _____ .
Intended use _____ .
For Testing _____ .

10.3 Testing: All testing shall be conducted by the Contractor Quality Control representative as specified herein at the expense of the Contractor.

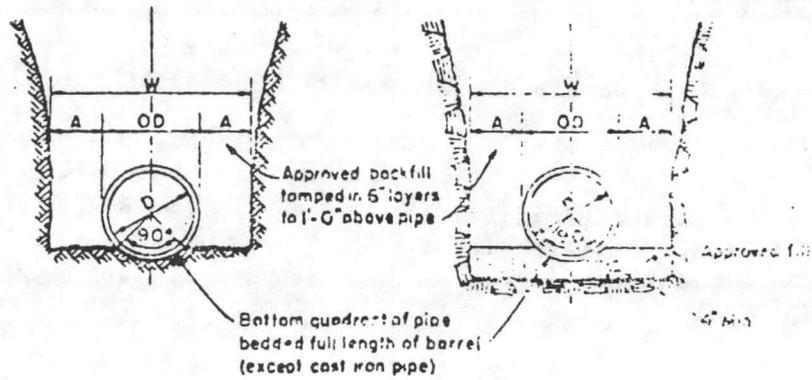
10.3.1 Granular Fill Testing: Gradation test shall be made on each sample in accordance with ASTM C136.

10.3.2 Soil materials shall be tested for liquid limit in accordance with ASTM D423, plasticity index in accordance with ASTM C424, material finer than No. 200 sieve in accordance with ASTM C1140. One test shall be performed for each source of material used or whenever the source is changed.

10.3.3 Compaction Testing: Compaction shall be made in randomly selected locations in accordance with ASTM D1556 or ASTM D2922 as follows:

Materials	Test Frequency
(1) Fill and Backfill	1 per lift per 2000 sq. ft.
(2) Subgrade (existing in-place density)	1 per lift per 2500 sq. ft.
(3) Embankment	1 per lift per 500 cu. ft.

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TRENCH IN EARTH

TRENCH IN ROCK

Pipe Dia "C"	Maximum "W"
0" to 12"	8"
12" to 24"	10"
24" to 30"	12"
30" to 42"	15"
42" & Larger	18"

Maximum trench width "W"
taken at top of pipe

STANDARD PIPE TRENCH BEDDING

LANTDIV PLATE

SECTION 02501. STORM DRAINAGE SYSTEMS

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent required by references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal Specifications:

RR-F-621b	Frames, covers, gratings, steps, sump and catch basin, manhole.
RR-G-661c	Grating, metal, bar type (floor, except for Naval vessels).
SS-S-210A(1)	Sealing compound, preformed plastic, for expansion joints and pipe joints.
WW-P-421c	Pipe, cast gray and ductile iron, pressure (for water and other liquids).

1.2 American Society for Testing and Materials (ASIM):

C 14-74	Concrete Sewer, Storm Drain, and Culvert Pipe.
C 32-73	Sewer and Manhole brick (made from clay or shale).
C 62-69	Building Brick (Solid Masonry Units Made From Clay or Shale).
C 76-74	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
C 139-73	Concrete Masonry Units for Construction of Catch Basins and Manholes.
C 443-74	Joints for circular concrete sewer and culvert pipe, using flexible, watertight, rubber type gaskets.
C 478-74	Precast reinforced concrete manhole sections.
C 506-78	Reinforced concrete arch culvert, storm drain and sewer pipe.
C 663-73a	Asbestos cement storm drain pipe.

~~A-53-78~~ Welded and Seamless Steel Pipe

1.3 American National Standards Institute (ANSI):

A 21.10-71	Gray iron and ductile iron fittings, 2" through 48" for water and other liquids.
A 21.11-72	Rubber gasket joints for cast iron and ductile iron pressure pipe fittings.
A 21.51-71	Ductile iron pipe centrifugally cast in metal molds or sand lined molds for water or other liquids.

1.4 North Carolina Department of Transportation and Highway Safety (NCDOT):

Add the following to the listing:

"C 507-78	Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe."
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"Standard Specification for Roads and Structures",
dated July 1, 1972.
"Roadway Standards", dated July 1, 1972.

1.5 American Water Works Association (AWWA):

- C 110-71 Gray iron and ductile iron fittings, two inches through 48 inches for water and other liquids.
- C 111-72 Rubber gasket joints for cast iron and ductile iron pressure pipe and fittings.
- C 151-71 Ductile iron pipe centrifugally cast in metal molds or sand lined molds for water or other liquids.

1.6 LANTDIV Plates:

- SD-1 Standard Catch Basin.
- SD-2 Standard Airfield Manhole.
- SD-3 Standard Airfield Catch Basin.
- SD-4 Standard Airfield Shallow Catch Basin, Types "A" & "B".
- SD-5 Standard Curb Inlet, Type "A" - 4 foot throat.
- SD-6 Standard Curb Inlet, Type "B" - 7 foot throat.
- SD-7 Standard Manhole, Drainage.
- SD-8 Standard Drop Manhole, Drainage.
- SD-9 Gravity Concrete Headwall, Type "A".
- SD-10 Gravity Concrete Headwall, Type "B".
- SD-11 Reinforced Concrete Headwall, Type "C".
- SD-12 Airfield Catch Basin Frame Details, Standard Type "A".

"1.7 American Wood Preservers Association (AWPA):
"Book of Standards", dated June 11, 1979."
in the presence of
representative.

3. SUBMITTALS:

3.1 Material Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

3.2 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:

- a. Pipe and Jointing Materials
- b. Brick

- c. Masonry Units
- d. Precast Manholes
- e. Frames, Grates and Covers for Drainage Structures

3.2.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specifications"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specification and of the reference specifications listed:

MANUFACTURER AND PRODUCT

REFERENCE SPECIFICATION

John Doe Company
Portland Cement, Type I

ASTM C150-74, Type I

SIGNATURE AND TITLE

3.3 Catalog Data: Submit complete descriptive literature for each type of each of the following items. Data which describe more than one type, size, model, or item shall be clearly marked to indicate which type, size, model, or item the Contractor intends to provide. Data shall be sufficient to show conformance to specified requirements.

- a. Frames, Graves, and Covers for Drainage Structures.
- b. Pipe Couplings and Gaskets.
- c. Precast Manholes.

4. STORAGE AND HANDLING: Proper facilities shall be provided for handling and lowering sections of pipe into place to avoid injury or damage. Damaged pipe or pipe with damaged coatings shall be removed from the site and replaced with satisfactory pipe at no additional cost to the Government.

5. MATERIALS:

5.1 Concrete Pipe: Pipe sizes under 12-inch diameter shall be nonreinforced concrete pipe. Pipe sizes 12-inch diameter through 24-inch diameter may be either reinforced or non-reinforced concrete pipe. Pipe sizes larger than 24-inch diameter shall be reinforced concrete pipe.

- 5.1.1 Non-Reinforced Concrete Pipe: ASTM C14, Class 2.
- 5.1.2 Reinforced Concrete Pipe: ASTM C76. Pipe shall be Class III, unless otherwise indicated.
- 5.1.3 Concrete Arch Pipe: ASTM C506
- "5.1.4 Concrete Elliptical Pipe: ASTM C507." -
- 5.2 Joints for Concrete Pipe: Joints shall be one of the following types:
- a. Bell and spigot with rubber gaskets.
 - b. Tongue and groove with rubber gaskets.
 - c. Tongue and groove with preformed plastic gaskets.
- 5.2.1 Rubber Gaskets: ASTM C443. Only a neutral agent shall be used as a lubricant.
- 5.2.2 Preformed Plastic Gaskets: SS-S-210, Type I-rope form.
- 5.3 Ductile Iron Pipe.
- (a) Ductile-iron pipe shall conform to the applicable requirements of ANSI A21.51 (AWWA C151), except as modified by WW-P-421, outside coated, cement-mortar lined.
- 5.4 Cast Iron Fittings.
- 5.4.1 Fittings for ductile iron pipe shall conform to the applicable requirements of ANSI A21.10 (AWWA C110) and may be either cast gray or ductile iron; fittings with push-on joint ends shall be as specified for bell-and-spigot joint ends except that bell design shall be modified, as approved, for push-on joints. Fittings shall have pressure rating at least equivalent to that of the pipe. Fittings shall have cement mortar lining equivalent to that of the pipe lining.
- 5.5 Joints and Joint Materials for Cast Iron Pipe.
- 5.5.1 Push-on Joints: Shape of pipe ends shall conform to the applicable requirements of WW-P421 for Type II pipe. Conformation of ends for fittings shall conform to the applicable requirements of ANSI A21.11 (AWWA C111). Gaskets and lubricants for pipe and fittings shall conform to the applicable requirements of ANSI A21.11 (AWWA C111). Drawings of the joint and gasket shall be furnished.
- 5.5.2 Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to the applicable requirements of ANSI A21.11 (AWWA C111) or to the applicable requirements specified for Type III pipe in WW-P421.

5.5.3 Adapters: Adapters shall be provided for connection of cast-iron pipe or asbestos-cement pipe to flanged accessories.

5.6 Asbestos Cement Pipe: ASTM C 663, Type II. Pipe class shall be III.

5.7 Joints in Asbestos Cement Pipe: As specified in ASTM C 663.

5.8 Drainage Structures: Unless indicated otherwise on the drawings or specified otherwise herein, drainage structures shall be in accordance with the LANTDIV Plates at the end of this section. Structures shall be constructed of clay brick, solid concrete masonry units, or cast in place concrete, except that airfield catch basins, headwalls, gutters and top of curb inlets, and bases of all structures shall be concrete. Precast concrete structures may be provided at the Contractor's option. The applicable LANTDIV Plate numbers for each respective type of structure is as follows:

Catch Basins	SD-1, SD-2, SD-3, SD-4.
Curb Inlets	SD-5, SD-6.
Manholes	SD-7, SD-8.
Headwalls	SD-9, SD-10, SD-11.

5.8.1 Brickwork: ASTM C 32 for standard size, Grade MS, or ASTM C62 for standard size, grade SW brick, except that the absorption test will be waived. Joints in walls other than circular shall be laid in stretcher courses with every 5th course to be a header course with full close joints. Cement mortar shall be mixed in the proportion of one part Portland Cement and 2 parts of approved mortar sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mix. Water shall be potable and free from harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

5.8.2 Solid Concrete Masonry Units: ASTM C139. Masonry units shall be laid in horizontal courses with vertical joints broken; shall be laid in mortar and all joints shall be completely filled with mortar. Mortar shall be as specified above for brickwork.

5.8.3 Metal Work: Except as specified or indicated otherwise, material shall conform to the requirements of RR-F-621 and shall be of cast iron. Frames, covers, and gratings in paved areas and where otherwise indicated or specified shall be of the "traffic" design of RR-F-621. Steel shapes, plates, bars and rods shall be standard commercial steel. Surfaces of steel frames and covers shall be cleaned, primed, and painted as specified in section titled, "Field Painting". Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel gratings shall be welded construction and conform to the applicable requirement of RR-G-661, Type I, end banded. Steps are required in manholes and catch basins more than 4 feet deep.

5.8.4 Precast concrete manholes: Risers and tops shall conform to ASTM C478, except that spacing of manhole steps or ladder rungs shall not exceed 12 inches. They shall be laid in full beds of mortar. Concrete precast and cast-in-place bases shall have smooth inverts accurately shaped to a semi-circular bottom conforming to the inside contour of the adjacent sewer sections. Changes in direction of the sewer and entering branches into the manhole shall have a circular curve in the manhole invert of as large a radius as the size of the manhole will permit. Joints in precast sections shall be made with preformed plastic gaskets conforming to SS-S-210. Precast manholes shall be provided with a 12-inch layer of gravel bedding under the concrete bases of the manholes.

5.8.5 Headwalls: Headwalls shall be constructed of concrete.

5.8.6 Paved Ditches: Paved ditches shall conform to the Section entitled "Cast-in-Place Concrete" and shall be provided with 1/2 inch expansion joints at 30 feet intervals and grooved joints 1 inch deep at 10 feet intervals between expansion joints. Provide wood float finish.

5.9 Flared Ends: NCDOT "Standard Specifications for Roads and Structures" and "Roadway Standards". Material used shall be the same as that used for the pipe. Flared ends are in addition to the lengths of pipe shown. Grading at flared ends, unless otherwise shown, shall be in accordance with the applicable standards of the NCDOT "Roadway Standards" with respect to the type of material used for flared ends, i.e., concrete or metal.

5.10 Cleanouts. Cleanouts indicated on the drawings shall be as specified in section entitled "Exterior Sanitary Gravity Sewers".

5.11 Valves: Valves and gates shall conform to the section entitled "Piping and Valves" in Division 15 - Mechanical.

5.12 Post Indicator Valves. Gate valves with indicator posts shall be as specified in section entitled "Piping and Valves".

5.13 Storm Water Drainfields and Underdrains: Storm water drainfield and underdrain systems shall be provided as specified in section entitled "Exterior Sanitary Gravity Sewers".

6. REQUIREMENTS: Work in this section includes storm drainage systems outside of building. Drain piping within building and within the five-foot building line (line drawn five feet outside the outside face of building walls and parallel thereto) is specified in the section entitled "Plumbing". Concrete, asbestos cement, or ductile iron pipe shall be used for storm drainage system. Except as otherwise indicated, manholes, catch basins, junction boxes, and inlets shall be constructed of masonry or reinforced concrete. Excavating, trenching, backfilling, and density tests are specified in section titled "Earthwork". Concrete is specified in section titled "Cast-in-Place Concrete".

7. INSTALLATION: Each section of pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Pipe shall be laid true to the grades indicated and shall rest upon the pipe bed for the full length of each section. Provide batterboards spaced not more than 26 feet apart along the trench for checking installation of pipe to insure proper slope and elevation. Laser beam method may be used for insuring proper slope and elevation. Runs of pipe shall be laid with outside laps or grooved ends upgrade beginning at the lower end of the pipe line. Pipe having its grade or joint disturbed after laying shall be taken up, cleaned, and relaid. When pipes are protected by head walls or connect with drainage structures, the exposed ends of the pipe shall be placed or cut flush with the face of the structure. After the pipe is cut, the rough edges shall be smoothed up in an approved manner. All pipe shall be laid so that markings are on top and the inner surfaces abut neatly, tightly, and smoothly. All pipe in place shall be inspected and approved before being covered and concealed.

7.2 Concrete Pipe Joints:

7.2.1 Rubber gasket and preformed plastic joint installation shall be in accordance with the printed recommendations of the manufacturer of the joint material. 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 installation of the pipe, and 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 the joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

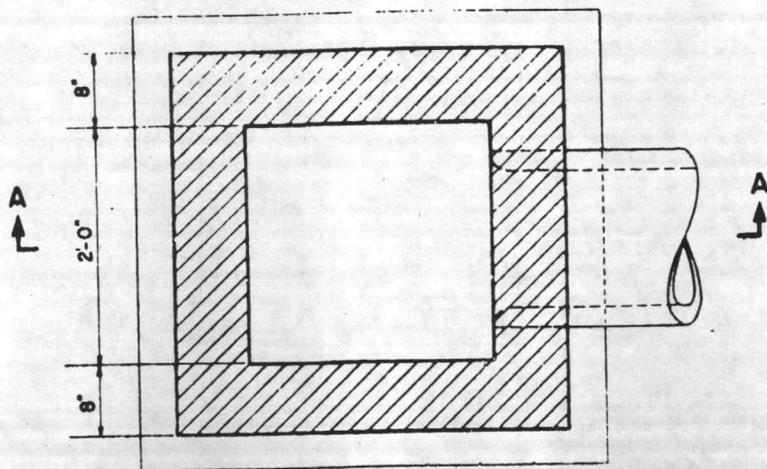
7.3 Joints for asbestos-cement pipe shall be made with couplings and sealing rings. Joints between asbestos-cement pipe and cast-iron fittings shall be push-on joints or mechanical joints. Sealing rings as specified hereinbefore shall be used with push-on joints; gaskets for mechanical joint shall conform to ANSI A21.11 (AWWA C111).

7.4 Joints for Ductile Iron Pipe: Push-on mechanical joints shall be made in accordance with the requirements of AWWA C 600; mechanical joints shall further follow the "Notes on Installation of Mechanical

Joints" given in ANSI A21.11 (AWWA C111). Flanged-joints shall be made up tight, care being taken to avoid undue strain on flanges, valves, fittings, pump nozzles, and other equipment and accessories.

8. TEST PROCEDURES: A light held in a manhole shall show a practically full circle of light through the pipe when viewed from the adjoining end of the line. Lines under pavement shall be tested for infiltration by means of a suitable weir or other device as directed. When determination of infiltration is not practicable because of dry trench conditions, an exfiltration test shall be applied by filling with water so that the hydraulic head will be at least 4 feet above the crown of the upper end of the section being tested. The amount of leakage infiltration or exfiltration shall not exceed 200 gallons per inch of diameter per day per mile of pipe. Water for testing shall be furnished by the Contractor.

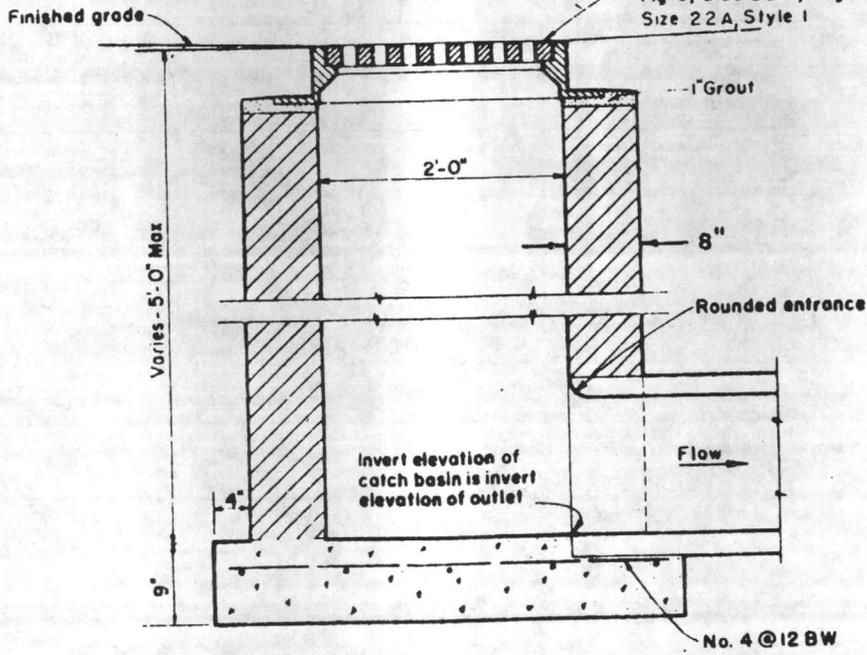
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CAPACITY TABLE	
Head ft	Capacity cfs
0.2	2.4
0.4	3.4
0.6	4.2
0.8	4.9
1.0	5.4

PLAN

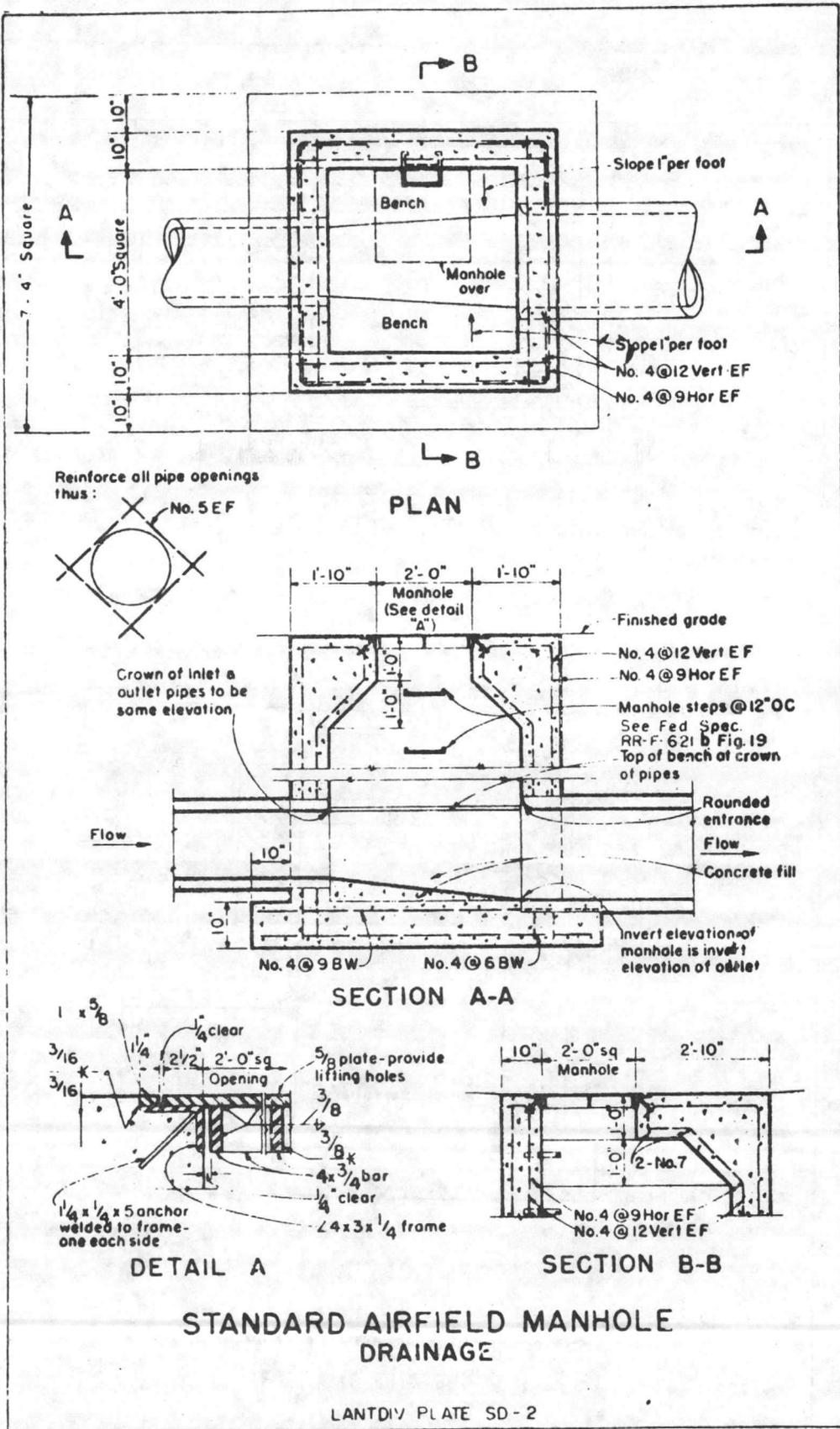
For frame and grating see
Fed Spec RR-F-621b
Fig 6, Size 22 A, Fig 14,
Size 22 A, Style 1



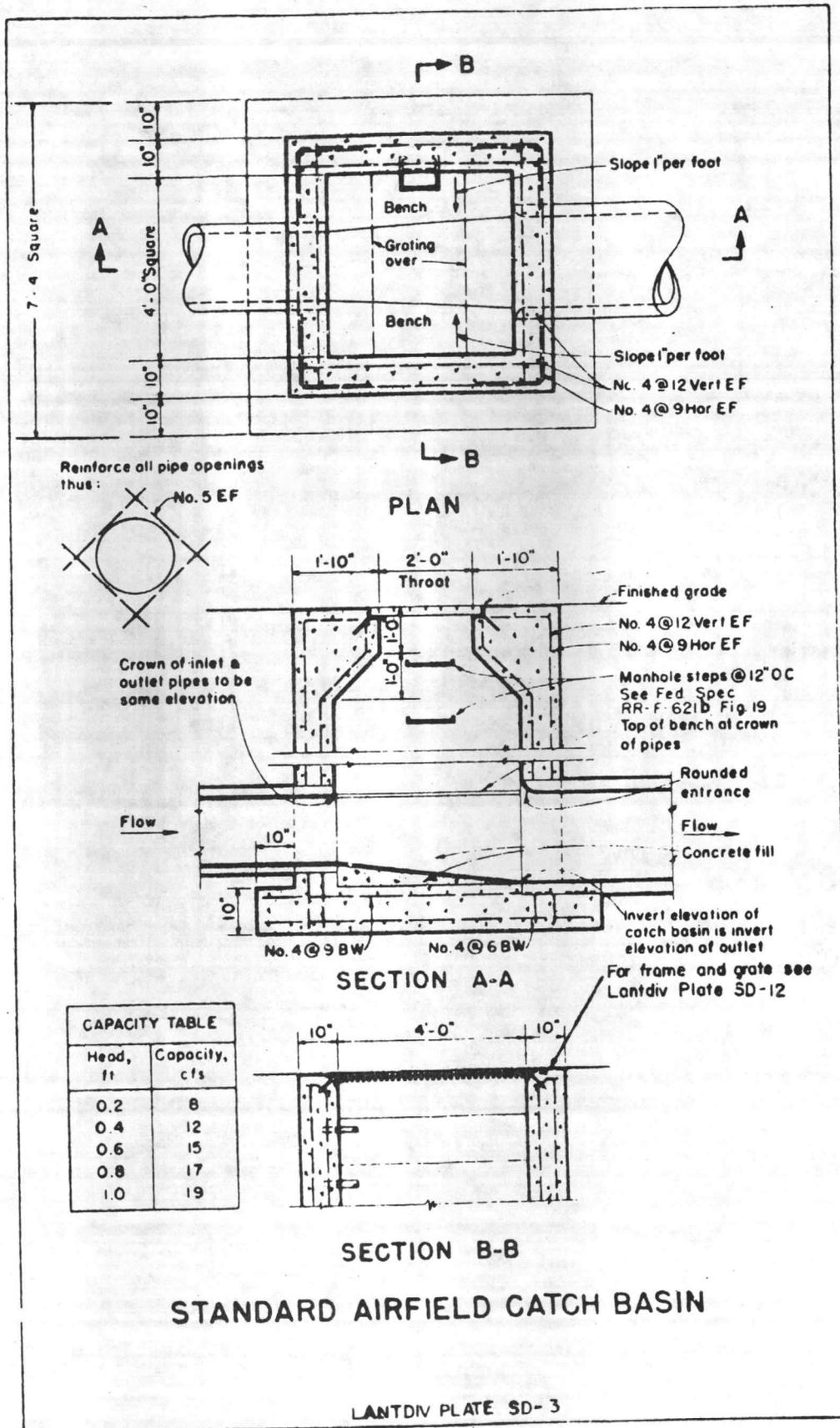
SECTION A-A

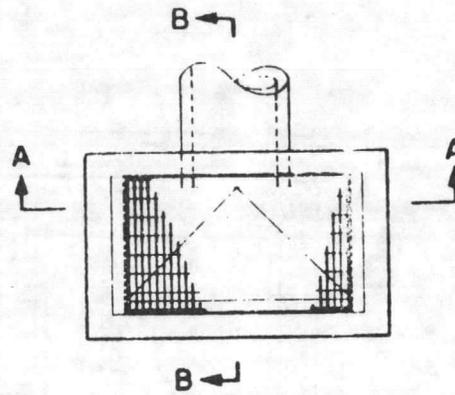
STANDARD CATCH BASIN
18" PIPE AND SMALLER

LANTDIV PLATE SD-1

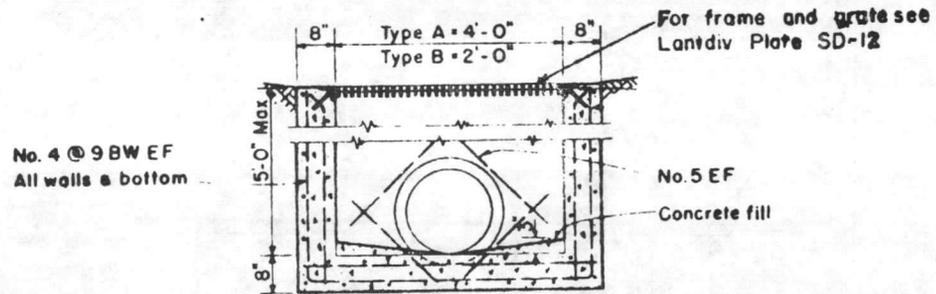


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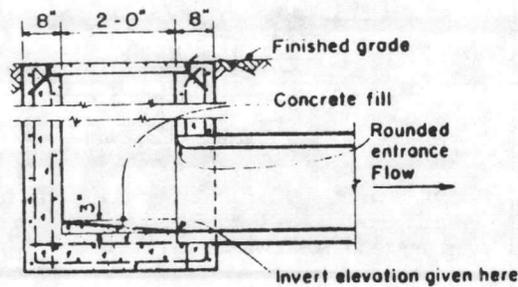


PLAN



SECTION A-A

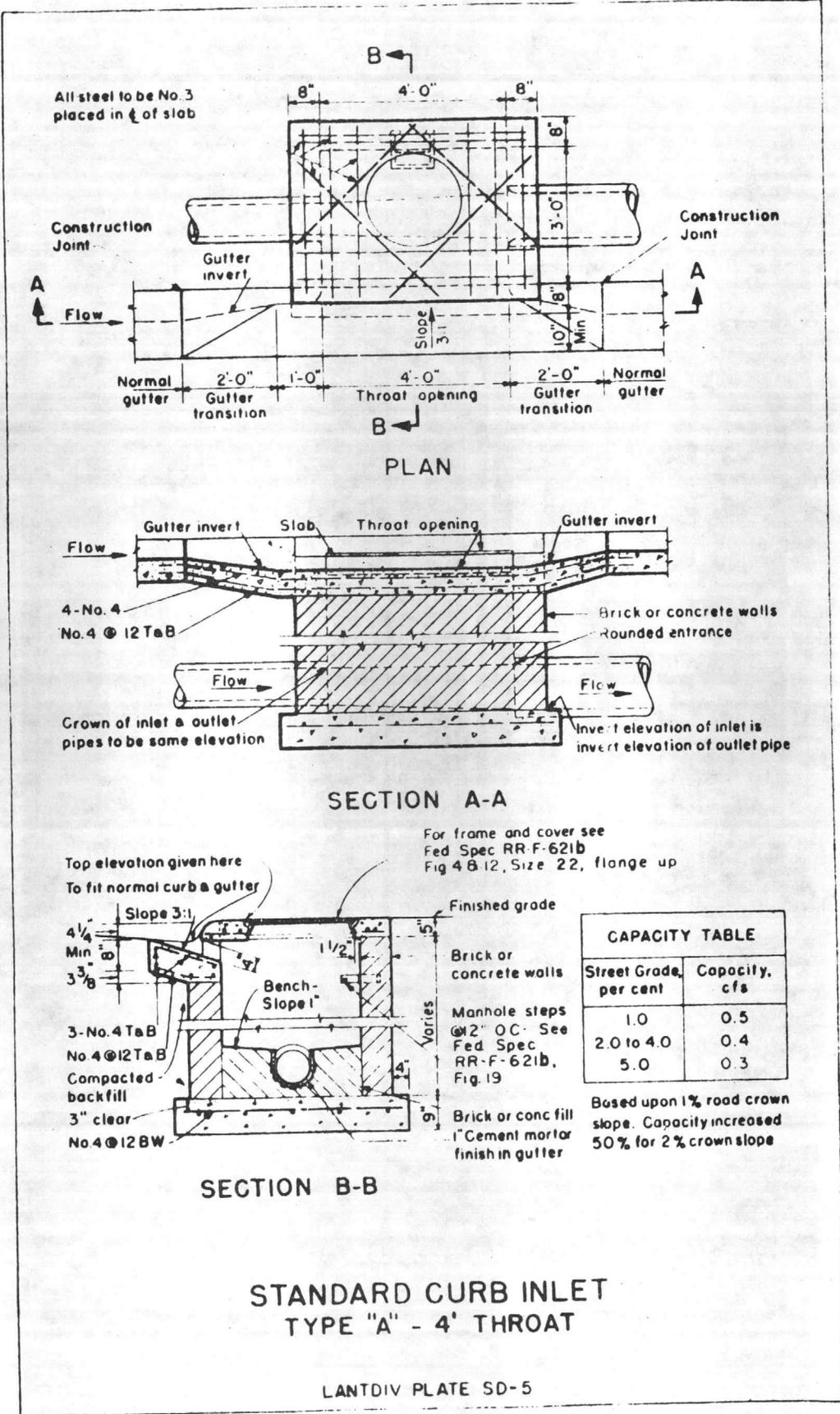
Head, ft	Capacity, cfs	
	Type "A"	Type "B"
0.2	8	4
0.4	12	6
0.6	15	7
0.8	17	8
1.0	19	9

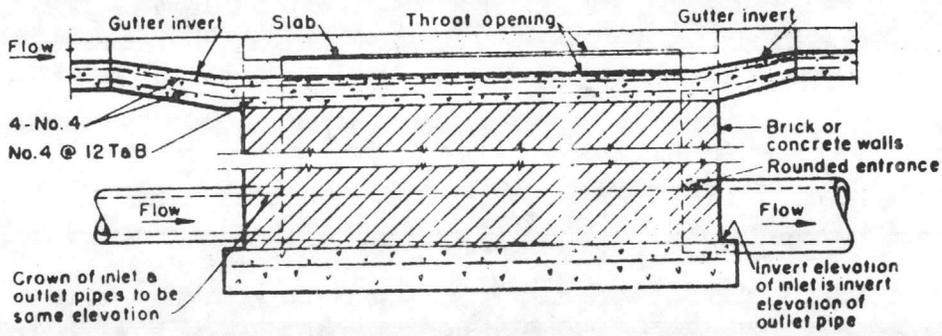
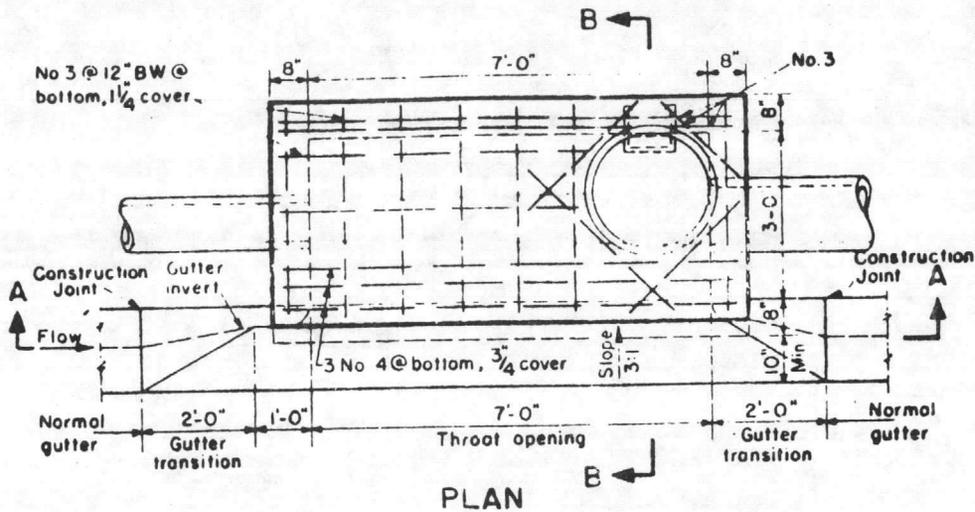


SECTION B-B

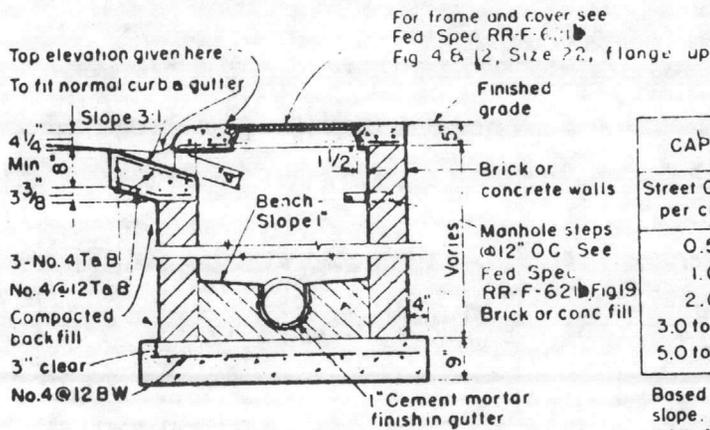
STANDARD AIRFIELD SHALLOW CATCH BASIN TYPES "A" & "B"

LANTDIV PLATE SD-4





SECTION A-A



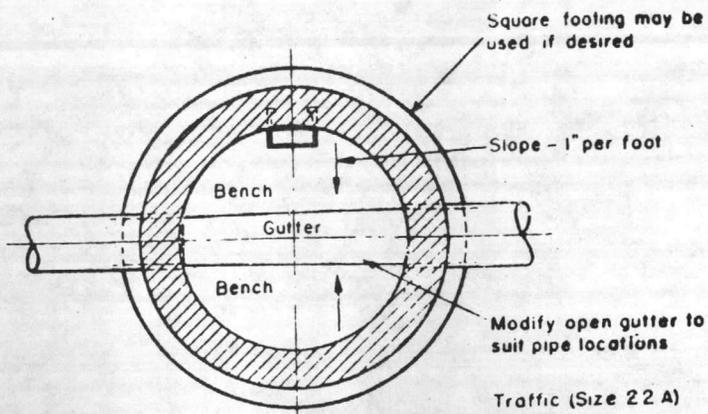
CAPACITY TABLE	
Street Grade, per cent	Capacity, cfs
0.5	1.3
1.0	1.1
2.0	1.0
3.0 to 4.0	0.9
5.0 to 6.0	0.8

Based upon 1% road crown slope. Capacity increased 50% for 2% crown slope

SECTION B-B

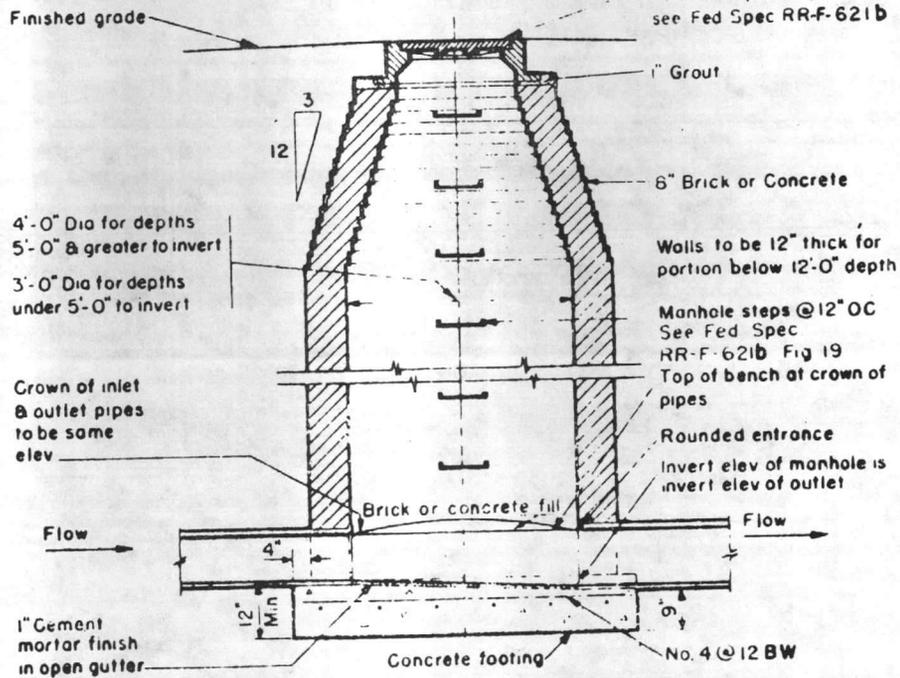
**STANDARD CURB INLET
TYPE "B" - 7' THROAT**

LANTDIV PLATE SD-6



PLAN

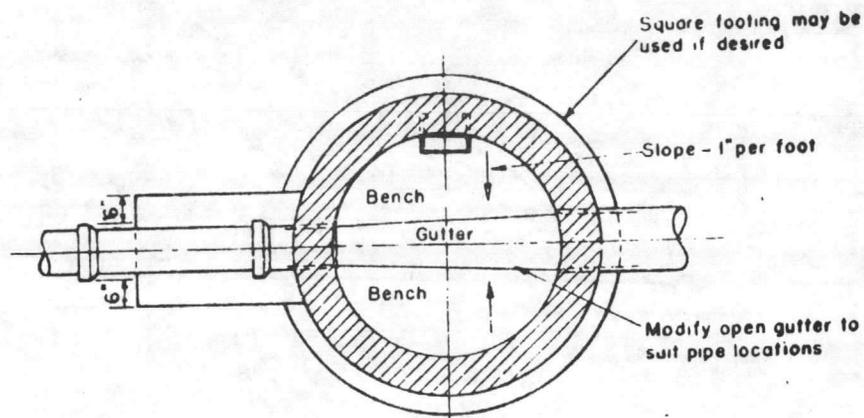
Traffic (Size 22 A)
 Frame- Fig 1
 Cover- Fig 8
 Grating- Fig 13, Style I
 Non-Traffic (Size 22)
 Frame- Fig 4
 Cover- Fig 12
 Grating- Fig 15
 For frame, cover, & grating
 see Fed Spec RR-F-621b



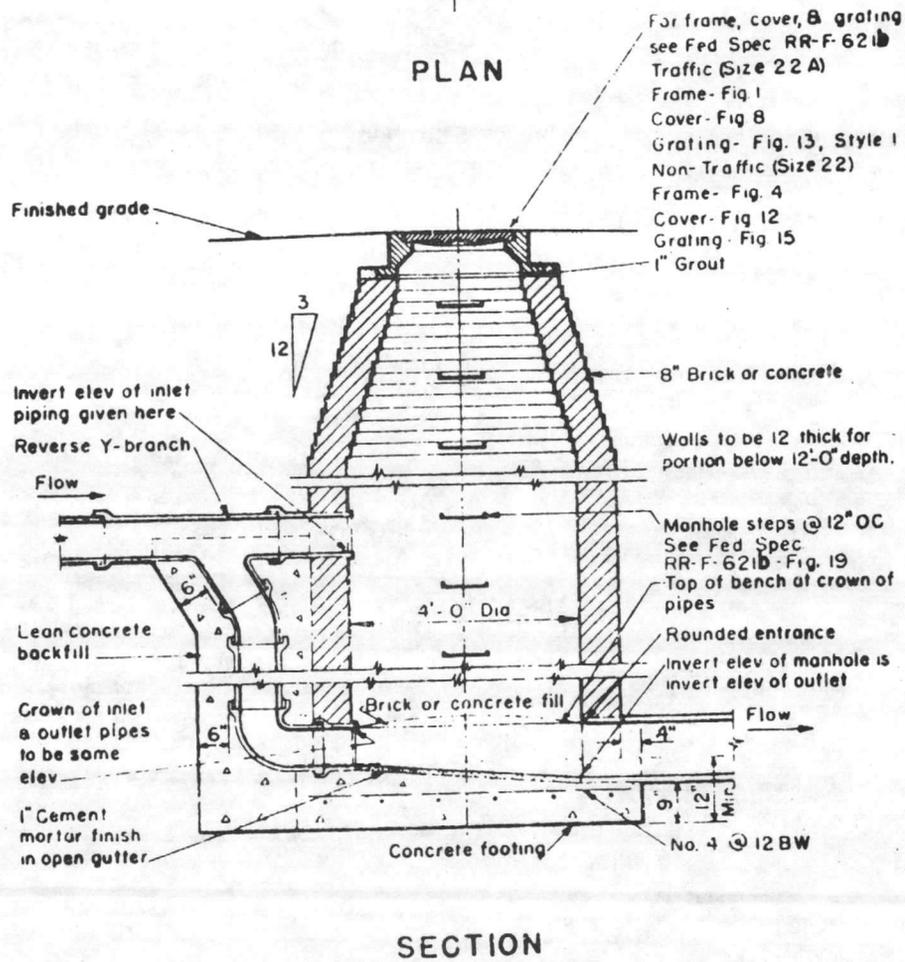
SECTION

**STANDARD MANHOLE
 DRAINAGE**

LANTDIV PLATE SD-7



PLAN



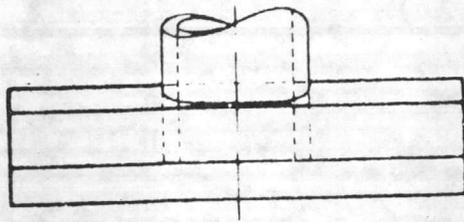
SECTION

STANDARD DROP MANHOLE DRAINAGE

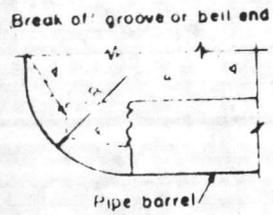
LANTDIV PLATE SD-8

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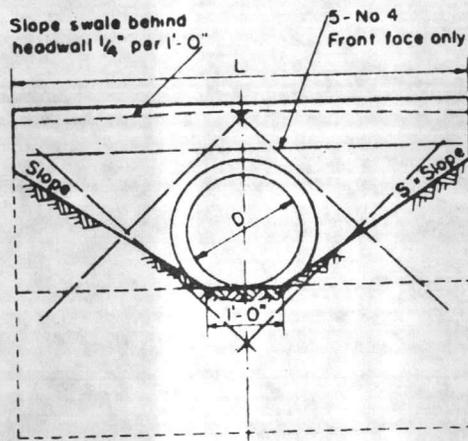
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PLAN

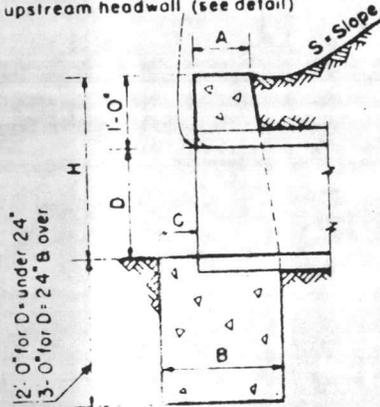


ROUNDED ENTRANCE
(UPSTREAM HEADWALLS ONLY)



ELEVATION

Downstream headwall as shown -
Provide rounded entrance for
upstream headwall (see detail)

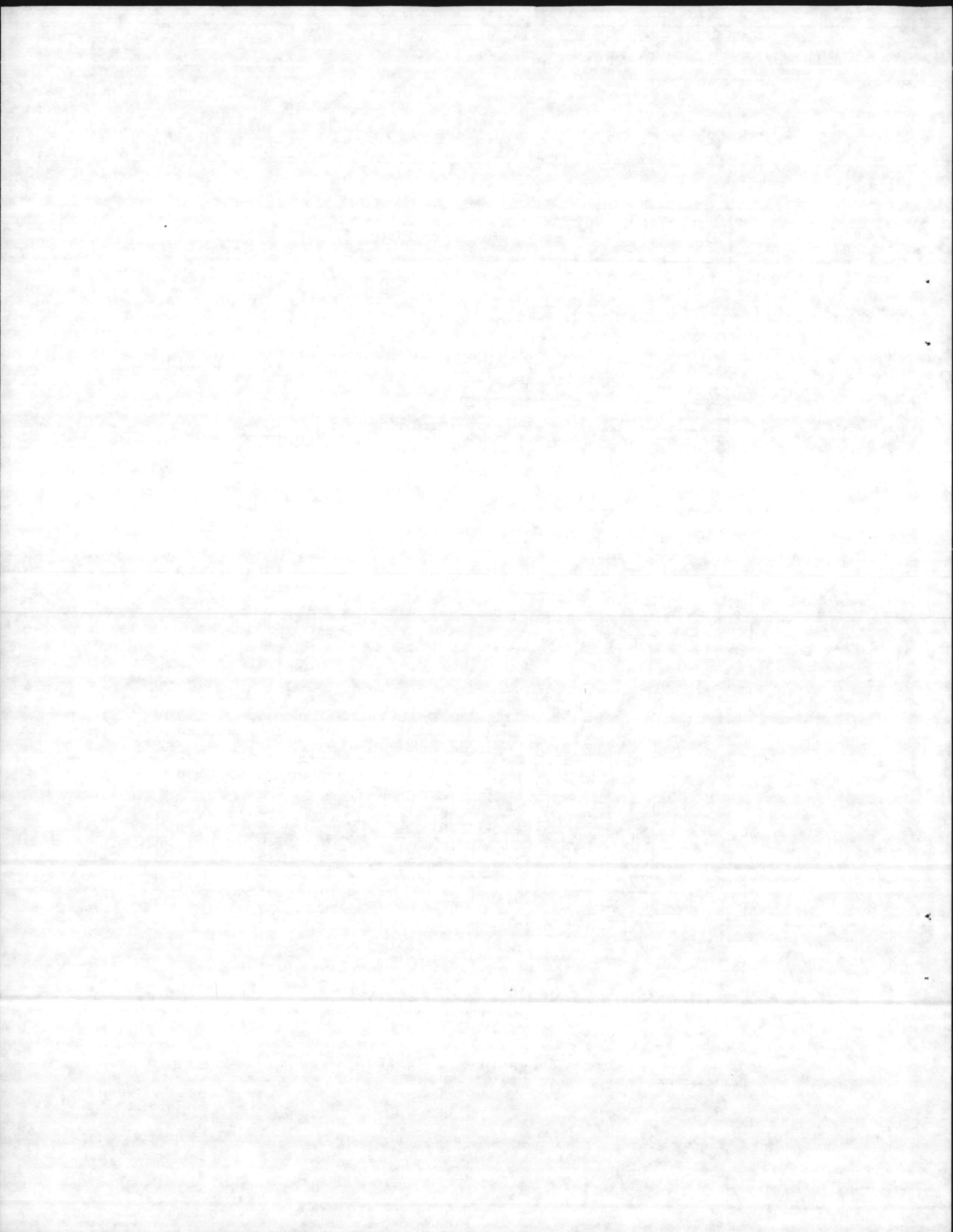


SECTION

ALL SLOPES						S=1/2:1	S=2:1	S=3:1
D	H	A	B	C	R	L	L	L
8"	1'-8"	8"	1'-0"	0	-	3'-6"	4'-2"	5'-6"
10"	1'-10"	8"	1'-0"	0	-	4'-0"	4'-10"	6'-6"
12"	2'-0"	10"	1'-4"	4"	-	4'-6"	5'-6"	7'-6"
15"	2'-3"	10"	1'-4"	4"	2 1/4"	5'-3"	6'-6"	9'-0"
18"	2'-6"	10"	1'-7"	6"	2 3/4"	6'-0"	7'-6"	10'-6"
21"	2'-9"	1'-0"	1'-8"	6"	3 1/8"	6'-9"	8'-6"	12'-0"
24"	3'-0"	1'-0"	1'-9"	6"	3 5/8"	7'-6"	9'-6"	13'-6"
27"	3'-3"	1'-2"	2'-0"	8"	4"	8'-3"	10'-6"	15'-0"
30"	3'-6"	1'-3"	2'-1"	8"	4 1/2"	9'-0"	11'-6"	16'-6"
36"	4'-0"	1'-6"	2'-4"	10"	5 1/2"	10'-6"	13'-6"	19'-6"
42"	4'-6"	1'-6"	2'-7"	12"	6 3/8"	12'-0"	15'-6"	22'-6"

GRAVITY CONCRETE HEADWALL
TYPE "A"

LANTDIV PLATE SD-9



SECTION 02711. FENCE, CHAIN-LINK

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

1.1 Federal Specifications:

FF-P-101E & Am 2	Padlocks.
RR-F-191 G/GEN	Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories).
RR-F-191/1A & Am 1	Fencing, Wire and Post, Metal (Chain-Link Fence Fabric).
RR-F-191/2A & Am 1	Fencing, Wire and Post, Metal (Chain-Link Fence Gates).
RR-F-191/3A & Am 1	Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces).
RR-F-191/4A	Fencing, Wire and Post, Metal (Chain-Link Fence Accessories).

1.2 Military Specification (Mil. Spec.):

MIL-B-52775A & Am 1	Barbed Tape, Obstacle, General Purpose and Barbed Tape, Fence Topping.
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1.3 American Society for Testing and Materials (ASTM) Publications:

C94-74a	Ready-Mixed Concrete.
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2. SUBMITTALS:

2.1 Shop Drawings: Submit shop drawings or catalog cuts showing all fencing components and details of fencing, gates, barbed tape, post tops, extension arms, tension bands and bars, sleeves, ties and clips. These drawings or cuts shall be accompanied by a layout drawing showing the spacing of posts and location of all gate, corner, end and pull posts.

2.2 Certificates of Conformance or Compliance: Submit certificates from the manufacturer attesting that materials meet the requirements specified herein.

3. DELIVERY, STORAGE, AND PROTECTION: Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper protection against oxidation caused by ground contact.

4. MATERIALS: Materials shall conform to referenced specifications and other requirements as specified herein.

4.1 Chain-Link Fencing, Fabric, Gates, Posts, Top Rails, Braces, and Accessories: Fed. Spec. RR-F-191/Gen and detailed specifications are referenced herein.

4.1.1 Chain-Link Fencing Fabric: Fed. Spec. RR-F-191/1; Type I, zinc-coated steel, 9 gage coated wire size II, aluminum coated steel, 9 gage coated wire size or Type IV, aluminum alloy, 6 gage coated wire size. Mesh size shall be 5.1 centimeters (2-inch). Minimum weight of zinc for zinc-coated steel shall be 1.2 ounces per square foot of uncoated wire. Selvage shall be twisted and barbed at both selvages.

4.1.2 Chain-Link Fencing Gates: Fed. Spec. RR-F-191/2; Type I, single swing and Type III, double swing. Shape and size of the gate frame shall be as indicated. Framing and bracing members shall be round or square of steel alloy. Steel member finish shall be zinc-coated. Gate fabric shall be as specified herein for chain-link fencing fabric. Barbed wire top on gate shall be as specified herein. Coating on latches, stops, hinges, keepers, and accessories shall be zinc-coated steel having weight of zinc-coating not less than 1.2 ounces per square foot. Gate latches shall be fork type. Gate leaves more than 8 feet wide shall have intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for packlocking so that padlock will be accessible from both sides of the gate regardless of latching arrangement.

4.1.3 Chain-Link Fencing, Posts, Bottom Rails and Braces: Fed. Spec. RR-F-191/3; posts type I, class 4, steel H sections or 5, steel square sections; bottom and top rails type II, Class 1, steel pipe; braces type III, class 1, steel pipe. Material shall be zinc-coated steel; weight of zinc coating shall be 1.6 ounces per square foot of base metal surface.

4.1.4 Chain-Link Fencing Accessories: Fed. Spec. RR-F-191/4.

4.1.5 Concrete: ASTM C94, using 3/4-inch maximum-size aggregate, and having minimum compressive strength of 3,000 psi at 28 days. Proportion grout one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

4.1.6 Padlocks: Fed. Spec. FF-P-101, Type EPB, 1-3/4 inch size, with chain.

5. INSTALLATION: Install the fence on previously prepared surfaces to line and grade as indicated. Install fence in accordance with the fence manufacturer's written installation instructions except as modified herein.

5.1 Excavation: Excavate for concrete-embedded items to the dimensions indicated, except in bedrock. If bedrock is encountered before reaching the required depth, continue the excavation to the depth indicated or 18 inches into the bedrock, whichever is less, and a minimum of 2 inches larger than the outside diameter of the post. Clear post holes of loose material. Dispose of waste material as directed.

5.2 Post Setting: Set posts plumb, within a tolerance of 4 degrees. Provide concrete bases of dimensions indicated except in bedrock. Thoroughly compact concrete to be free of voids and finish in a dome. Straight runs between braced posts shall not exceed 500 feet. In bedrock, set posts with a minimum of one inch of grout around each post. Thoroughly work grout into the hole so as to be free of voids and finish in a dome. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.

5.3 Post Caps: Install post caps as recommended by the manufacturer.

5.4 Bottom Rails: Install bottom rails before installing chain-link fabric. Provide expansion coupling spaced as indicated.

5.5 Top tension Wires: Install top tension wires before installing chain-link fabric and pull the wires taut.

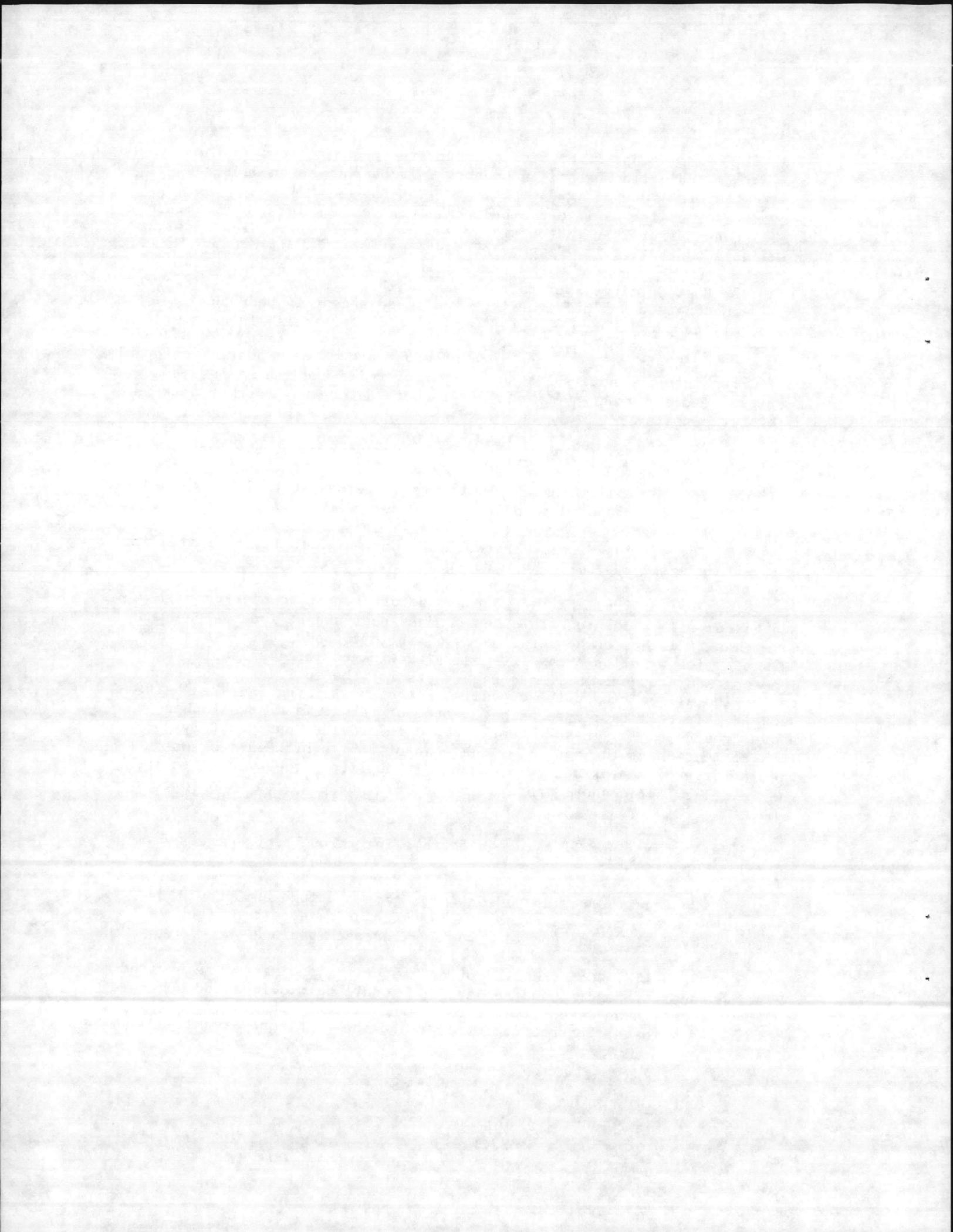
5.6 Fabric: Pull fabric taut and secure fabric to the top rail and bottom rail close to both sides of each post and at intervals of not more than 24 inches on centers. Secure fabric to posts using stretcher bars and ties or clips or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for the full length of each post. Install fabric on the opposite side of posts from the area being secured. Install fabric such that bottom of fabric is at two inches above ground level. Install fence fabric to provide approximately 2 inch deflection at the center of the span of fabric between two posts, when a force of approximately 30 pounds is applied perpendicular to the fabric. The fabric should return to its original position when force is removed.

5.7 Gates: Install swing gates to swing through 180 degrees from closed to open.

5.8 Padlocks: Provide padlocks for gate openings and provide chains that are securely attached to the gate or gate posts. Provide padlocks keyed alike and provide two keys for each padlock.

6. SECURITY: Construction of new security fencing and removal of existing security fencing and related work shall be provided and scheduled to provide continuous security for the using activity and shall be fully coordinated with the Contracting Officer and the cognizant Security Officer.

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SECTION 02822.

ESTABLISHING VEGETATION

1. SUBMITTALS:

1.1 Material Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

1.2 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:

- | | |
|---------------|-------------|
| a. Fertilizer | d. Mulch |
| b. Lime | e. Asphalts |
| c. Seed | f. Topsoil |

1.2.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference specifications listed:

MANUFACTURER AND PRODUCT

REFERENCE SPECIFICATION

John Doe Company
Portland Cement, Type I

ASTM C150-74, Type I

SIGNATURE AND TITLE

1.3 Samples: Submit one sample of each of the following items:

- | | |
|---------|----------|
| a. Seed | b. Mulch |
|---------|----------|

2. QUALITY CONTROL:

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02822 - 1

2.1 Inspection and tests:

2.1.1 Seed: Furnish duplicate signed copies of a statement from the vendor, certifying that each container of seed is fully labeled in accordance with the Seed Improvement Association requirements for certification. This certification shall appear on, or with, all copies of invoices for the seed. Each lot of seed will be subject to sampling and testing at the discretion of the Contracting Officer. Sampling and testing will be in accordance with the latest regulation under the Federal Seed Act. Samples shall be submitted at least 40 days in advance of the planned planting date.

2.1.2 Fertilizer and Lime: Furnish duplicate copies of invoices for all fertilizer and lime used on the project. Invoices for fertilizer shall show the analysis and the quantity furnished. Invoices for lime shall show the percentage of magnesium oxide and quantity furnished. Upon completion of the project, a final check of the total quantities of fertilizer and lime used will be made against the total area seeded and if the rates of application have not been met, additional quantities of these materials shall be applied to make up the application specified.

3. MATERIALS:

3.1 Lime shall be dolomitic agricultural-ground limestone containing not less than 10 percent magnesium oxide.

3.2 Fertilizer shall be the standard commercial product of 10-10-10 analysis. All fertilizer shall be delivered in bags bearing the manufacturer's name, the chemical analysis of the product, and its weight. If not used immediately after delivery, fertilizer shall be stored in a manner that will not allow it to harden or destroy its effectiveness.

3.3 Seed shall be new crop seed labeled in accordance with the U.S. Department of Agriculture, "Rules and Regulations under the Federal Seed Act." All seed shall be furnished in sealed standard containers. Seed which has become wet, moldy, or otherwise damaged prior to seeding, will not be acceptable.

3.4 Mulch shall be any of the materials noted below:

3.4.1 Grain straw or dry hay: Mulch material which contains an excessive quantity of matured seed of noxious weed or other species which would hinder the establishment of desirable vegetation will not be acceptable. Any mulch material which is fresh or excessively brittle or which is in an advanced stage of decomposition as to smother or retard growth of grass will not be acceptable. Asphaltic material to anchor straw mulch shall be thin enough to be blown from spray equipment. It shall be SS-1, RS-1, or RS-2 asphalt emulsion.

3.4.2 Wood cellulose fiber mulch: Wood cellulose fiber mulch for use with the hydraulic application of grass seed and fertilizer shall consist of specially prepared wood cellulose fiber. It shall be processed in such a manner that it will contain no growth or germination inhibiting factors and shall be dyed an appropriate color to facilitate metering of materials. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizers, grass seeds, water, and any other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry; that when hydraulically sprayed on the ground, the material will form a blotterlike ground cover impregnated uniformly with grass seed; which after application, will allow the absorption of moisture and allow rainfall or mechanical watering to percolate to the underlying soil. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished, and that it meets all of the foregoing requirements based upon such testing. Weight specifications of this material from suppliers, and for all applications, shall refer only to air dry weight of the fiber material. Absolute air dry weight is based on the normal weight standard of the Technical Association of the Pulp and Paper Industry for wood cellulose and is considered equivalent to 10 percent moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dryweight content.

The topsoil shall be material stripped at site and shall be reasonable free from subsoil, clay lumps, brush, stumps, objectionable weeds, other litter, and any other material or substance which might be harmful to plant growth or a hindrance to grading, planting, or maintenance operation.

4. GENERAL REQUIREMENTS: The work includes seedbed preparation, liming, fertilizing, seeding and mulching of all graded areas that do not receive some form of final surface cover or treatment. The work also includes those areas inside or outside the limits of construction that are disturbed by the Contractor's operation.

5. SPECIAL SEEDING AND MULCHING EQUIPMENT:

5.1 Seeder: Equipment to be used for applying a seed-fertilizer mix over prepared slopes shall be a hydraulic seeder designed to pump a water-seed-fertilizer mixture over areas to be seeded at the specified rates. A power-driven agitator keeps the mixture uniform during the seeding cycle.

5.2 Mulch spreader: Equipment to be used for spreading mulch shall be equipment designed to apply an asphalt adhesive to the straw mulch material at the end of a movable boom, then with a high velocity air stream, blow the asphalt-sprayed straw over the graded areas to form a uniform, porous, stable blanket, tied in place by the asphalt adhesive.

5.3 Wood cellulose fiber mulch spreader: Hydraulic equipment used for the application of fertilizer, seed, and slurry or prepared wood

pulp shall have a built in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to 40 pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which will provide even distribution of the slurry on the various slopes to be seeded. The slurry tank shall have a minimum capacity of 1,000 gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. Equipment with smaller tank capacity may be used provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

6. SEEDBED PREPARATION: Equipment necessary for the proper preparation of the seedbed and for handling and placing of all required materials shall be on hand, in good condition and shall be approved before the work is started.

6.1 Clearing: Prior to or during grading and tillage operations, the ground surface shall be cleared of stumps, stones, roots, cable, wire, grade stakes, and other materials that might hinder proper grading, tillage, seeding, or subsequent maintenance operations.

6.2 Grading: Grades on the area to be treated shall be maintained in a true and even condition. Maintenance shall include any necessary repairs to previously graded areas.

6.3 Tillage: All graded areas shall be thoroughly tilled to a depth of at least 4 inches by plowing, disking, harrowing, or other approved methods until the condition of the soil is acceptable. On sites where soil conditions are such that high clay content and excessive compaction cause difficulty in getting clods and lumps effectively pulverized, the Contractor shall use the rotary tillage machinery, until the mixing of the soil is acceptable and no clods or clumps remain larger than 1-1/2 inches in diameter. A firm and compact seedbed is required, and after being graded, the seedbed shall be lightly compacted with a land roller, such as a cultipacker, before and after seeding. All tillage operations shall be as near on the contour as is practical but in no instance up and down the slope.

6.4 Topsoiling: The topsoil shall be uniformly distributed on the designated areas and evenly spread to an average thickness of 4 inches, with a minimum thickness of 3 inches. Prior to placing the topsoil, the subgrade, wherever excessively compacted by traffic or other causes, shall be loosened by disking or by scarifying to a depth of at least 2 inches, to permit bonding to the subgrade. The spreading shall be performed in such a manner that planting can proceed with little additional

soil preparation or tillage. Any irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of depressions where water will stand. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the planting or to proper grading.

LIMING

7. LIMING: Limestone shall be uniformly applied at the rate of 3000 pounds per acre (70 pounds per 1000 square feet) to all areas to be vegetated. Limestone may be applied to the area prior to the preparation of the seedbed, but in all cases, it shall be applied before seeding and thoroughly incorporated into the entire depth of the prepared seedbed. The incorporation of the lime may form a part of the tillage operation specified above.

8. FERTILIZING: The fertilizer shall be uniformly applied at the rate of 1000 pounds per acre (23 pounds per 1000 square feet) to all areas to be vegetated. The fertilizer shall be incorporated into the upper three or four inches of prepared seedbed. This can be done just prior to the last tillage operation or just prior to seeding, but in no case, will it be applied more than 3 days before seeding or before the lime is applied. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable. When hydroseeding equipment is used for planting operation, fertilizer shall be applied simultaneously with seed using the above rate of application.

9. SEEDING: The Contractor shall make use of special hydroseeding equipment or approved mechanical power-drawn seeders. When conditions are such, by reason of draught, high winds, excessive moisture, or other factors that satisfactory results are not likely to be obtained, the work shall be stopped, and resumed only when conditions are favorable.

If inspection during seeding operation, or after there is a show of green, indicates that strips wider than the space between the rows planted have been left, or other areas skipped, additional seed shall be sown on these areas. Seed shall be sown between March 15 and May 15 or between September 1 and October 15. Spring seeding shall be at the rate of 100 pounds per acre of the following seed mixture:

<u>Variety</u>	<u>Pounds</u>
Kentucky Fescue 31	80
Hulled Bermuda	20

Fall seeding shall be at the rate of 120 pounds per acre of the following seed mixture:

<u>Variety</u>	<u>Pounds</u>
Kentucky Fescue 31	100
Unhulled Bermuda	20

Note: The variety of seeds indicated shall be sown only during the optimum periods specified.

9.1 Broadcast Seeding: In areas too confined for the operation of machinery, hand-operated equipment, such as the "Cyclone" seeder, shall be employed. The seed shall be uniformly distributed over the designated areas. Half the seed shall be sown with the sower moving in one direction, and the remainder shall be sown with the sower moving at right angles to the first sowing. In confined areas, the seed shall be covered, but no deeper than 1/4-inch, by means of rakes or other approved hand tools. Broadcast seeding shall not be done during windy weather.

9.2 Slurry seeding: Seed shall be sown with an approved hydroseeder in combination with fertilizer, or in combination with wood cellulose fiber mulch and fertilizer. Seed shall be uniformly distributed over the areas to be seeded.

9.3 Mechanical power-drawn seeder: Seeder shall be accomplished with a combination grass planter and land packer or pulverizer. The seed shall be planted no deeper than 1/4-inch. The seeding operation should be as near on the contour as is practical, but never up and down the slope. After seeding, the seeded area shall be compacted with a land roller, such as a cultipacker. It will be permissible to sow the seed and cultipack the soil all in one operation if the proper equipment is used.

10. MULCHING: The surface of all seeded areas shall be protected by the application of any of the before-mentioned mulch material unless otherwise specified.

10.1 Straw or hay shall be applied evenly over the seeded area in such a manner that thickness of the mulch is approximately uniform throughout the treated area and sunlight is not completely excluded from penetration to the ground surface. The straw mulch shall be applied at the rate of one and one-half tons per acre.

10.2 Wood cellulose fiber mulch: The application of the wood cellulose fiber mulch shall be with the hydroseeder and shall be accomplished immediately after completion of the final tillage operation. The wood cellulose fiber mulch shall be applied at the rate of 1,000 pounds per acre in combination with water, fertilizer and seed and shall be sprayed over the soil in a uniform coat.

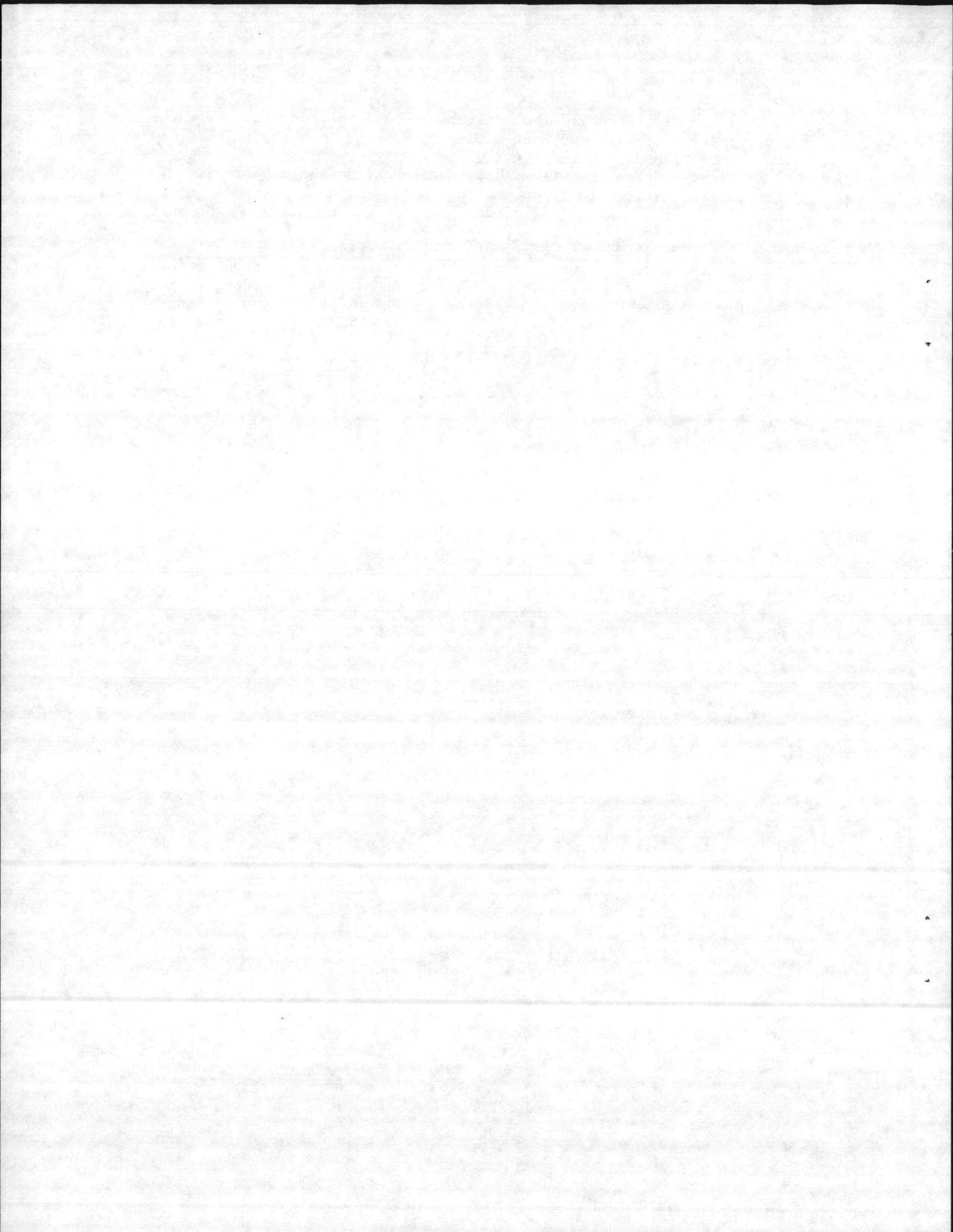
10.3 Anchoring mulch: Straw or hay mulch shall be anchored in place by use of a cut-away rolling flat disk packer or by uniformly spraying the straw with the specified asphalt material at the rate of 0.10 gallon residual asphalt per square yard.

11. PROTECTION: The area shall be protected against foot and vehicular traffic by erecting adequate barricades immediately after seeding is completed, and by placing warning signs of an approved type.

12. ESTABLISHMENT: The Contractor shall be responsible for the proper care of the seeded area during the period when the vegetation is being established. In the event of an erosive rain before an adequate stand of vegetation is established, damaged areas shall be repaired, limed, fertilized, seeded, and mulched wholly at the Contractor's expense. This period shall extend for 30 days after the completion of the mulching.

13. POSTPONEMENT OF SEEDING: If upon completion of the finish grading, the seeding cannot be completed during the specified periods, then the seeding shall be accomplished during the next seeding period specified. Only an amount considered sufficient by the Contracting Officer to cover payment for this work will be withheld from the progress payments. The beneficial occupancy of the facility shall not be delayed by the postponement of the seeding.

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SECTION 03301. CAST-IN-PLACE CONCRETE

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal and Military Specifications and Standards:

O-C-105C	Calcium Chloride, Dihydrate and Calcium Chloride, Anhydrous; Technical.
SS-S-1401B	Sealing Compound, Hot Applied, for Concrete and Asphalt Pavements.
UU-B-790A	Building Paper, Vegetable Fiber; (Kraft, Waterproofed, Water Repellent and Fire Resistant).

1.2 American Concrete Institute (ACI):

ACI 305-72	Recommended Practice for Hot Weather Concreting.
ACI 306-66	Recommended Practice for Cold Weather Concreting.
ACI 318-71	Building Code Requirements for Reinforced Concrete.
ACI 347-68	Recommended Practice for Concrete Formwork.

1.3 American Society for Testing and Materials (ASTM):

A 185-73	Welded Steel Wire Fabric for Concrete Reinforcement.
A 615-74a	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
C 31-69	Making and Curing Concrete Test Specimens in the Field.
C 33-74	Concrete Aggregates.
C 39-72	Compressive Strength of Cylindrical Concrete Specimens.
C 94-74a	Ready-Mixed Concrete.
C 138-75	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
C 143-74	Slump of Portland Cement Concrete.
C 150-74	Portland Cement.
C 172-71	Sampling Fresh Concrete.
C 231-75	Air Content for Freshly Mixed Concrete by the Pressure Method.
C 233-76	Air-Entraining Admixtures for Concrete; Testing.
C 260-74	Air-Entraining Admixtures for Concrete; Specifications.
C 309-74	Liquid Membrane-Forming Compounds for Curing Concrete.

Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).

2. QUALITY CONTROL: Provisions of the section entitled "Contractor Quality Control" shall apply. Unless otherwise specified herein, requirements for supervision, inspection, sampling, testing, approval, directing, authorizing, and other requirements of similar import shall be the responsibility of the Contractor's Quality Control representative. Approvals, except those required for field installations, field applications, and field tests shall be obtained before custom fabrication is started and before delivery of materials or equipment to the project site. All materials and materials sources shall be approved not less than 30 days prior to their use in the work.

3. SUBMITTALS:

3.1 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:

- a. Cement
- b. Aggregates
- c. Admixtures
- d. Reinforcing Steel
- e. Welded Wire Mesh
- f. Curing Materials
- g. Joint Sealing Materials
- h. Expansion Joint Filler
- i. Waterstops
- j. Form Ties

3.1.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference specifications listed;

MANUFACTURER AND PRODUCT

John Doe Company
Portland Cement, Type I

REFERENCE SPECIFICATIONS

ASTM C150-74, Type I.

SIGNATURE AND TITLE

3.2 Catalog Data: Submit complete descriptive literature for each type of each of the following items. Data which describe more than one type, size, model, or item shall be clearly marked to indicate which type, size, model, or item the Contractor intends to provide. Data shall be sufficient to show conformance to specified requirements.

a. Joint Sealer b. Preformed Expansion Joint Filler c. Form Ties

4. PROPORTIONING CONCRETE: The design of the concrete mixture using materials specified herein shall be the responsibility of the Contractor as set forth under Alternate No. 2 of the ASTM C94. The concrete produced shall have the following characteristics:

4.1 Compressive strength at 28 days shall not be less than 3,500 pounds per square inch.

4.2 Water-cement ratio shall not exceed 0.45 pounds of water per pound of cement.

4.3 Control: The strength quality of the concrete proposed for use shall be established by tests made in advance of operations.

4.4 Slump shall not be more than 3 inches for base slabs and footings and 4 inches for slabs, beams, walls and columns. (Slump shall not be less than one inch, minimum).

5. AIR-ENTRAINED CONCRETE: Air-entrained concrete shall be provided for all concrete. Air-entrainment shall be accomplished by using an air-entraining admixture. Air-entraining admixtures shall be added in solution in a portion of the mixing water by means of a mechanical batcher in a manner that will insure uniform distribution of the agent throughout the batch. Except as specified otherwise, the air content of freshly mixed air-entrained concrete shall be 5 to 7 percent of the concrete volume. The percentage of air shall be determined by ASTM C 231 on samples of concrete during placing of the concrete in the forms, except that for concrete made with slag aggregate ASTM C 138 shall be used.

6. MATERIALS:

6.1 Cement: Cement shall be Type I or II conforming to ASTM C150.

6.2 Water: Water for mixing and curing, including free moisture and water in the aggregates, shall be fresh, clean and potable.

6.3 Aggregates: Aggregates shall conform to ASTM C33, except as modified herein. Coarse aggregate shall be size No. 57 or 67.

6.4 Admixtures: Admixtures shall be used in the concrete as specified hereinafter. Chemical admixtures shall not be used without the written permission of the Contracting Officer. When more than one admixture is used in a mix, the Contractor shall furnish satisfactory evidence that the admixtures to be used are compatible in combination with the cement and aggregates to be used for the project and will be suitable at the job temperatures. The cost of the admixtures to be used for this project shall be included in the contract bid price.

6.4.1 Air-entraining admixtures conforming to ASTM C 260 shall be used in all concrete specified to be air-entrained. Certification that the air-entraining agent has been tested in accordance with ASTM C 233 shall be furnished by the Contractor.

6.5 Reinforcement:

6.5.1 Reinforcing bars: All reinforcing steel shall be deformed. Reinforcement shall conform to ASTM A615, Grade 60.

6.5.2 Welded wire fabric shall be electrically-welded fabric of cold-drawn wire of gage and mesh size shown on the drawings, and shall conform to ASTM A 185.

6.6 Materials for Curing Concrete:

6.6.1 Waterproof paper shall conform to UU-B-790.

6.6.2 Polyethylene sheeting shall be natural color and shall have a nominal thickness of 0.004 inch.

6.6.3 Polyethylene-coated burlap shall be 4 mil white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard.

6.6.4 Liquid membrane-forming compound shall conform to ASTM C 309, white-pigmented Type 2, and be free of paraffin or petroleum.

6.7 Joint-Sealing Materials: Joint-sealing materials shall conform to SS-S-1401.

6.8 Expansion Joint Filler: Expansion joint filler shall be preformed type conforming to ASTM D 1752.

6.9 Elastomer waterstops shall be made of natural or synthetic rubber or polyvinyl chloride; shall be dense, homogeneous, free from porosity and other imperfections, and symmetrical in shape. Materials shall be resistant to chemical action with portland cement; acids and alkalis, and not affected by fungi. They shall show no effect when immersed for 10 days at room temperature in 10 percent solutions of sulphuric acid, hydrochloric acid, and sodium chloride; and a saturated lime solution. Resistance to fungi shall be determined by ASTM G 21.

Material shall not be adversely affected when subjected to tests for low temperature brittleness (-35 degrees Fahrenheit), in accordance with ASTM 1329, and for water absorption (maximum 5 percent by weight). Waterstops not indicated otherwise shall be 6 inches by 3/8-inch.

6.10 Perimeter insulation shall be rigid one inch thick, 20 inches wide closed cell, expanded polystyrene or urethane.

6.11 Vapor barrier shall be 0.006 inch polyethylene sheeting.

7. FORMS:

7.1 General Requirements: Forms shall be provided for all concrete not indicated or specified otherwise. Forms shall be set true to line and grade and maintained so as to insure completed work within the allowable tolerances specified, and shall be mortar-tight. The Contractor shall be responsible for the adequacy of forms and form supports. Form ties shall have neoprene waterstops located at mid depth of wall. Ties shall be broken off at least 1½ inches from face of wall. Ties shall not be removed completely. All forms shall be constructed so that they can be removed without damaging the concrete. All exposed joints, edges, and external corners shall be chamfered a minimum of 3/4-inch unless specified otherwise hereinafter.

7.2 Materials for Forms: Forms shall be of wood, plywood, steel or other suitable material. Wood forms, for surfaces exposed to view in the finished structure and requiring a standard finish, shall be tongue-and-groove boards or plywood. For unexposed surfaces, undressed square-edge lumber may be used. Surfaces of steel forms shall be free from irregularities, dents and sags.

7.3 Coating: Before placing the concrete, the contact surfaces of forms shall be coated with a non-staining mineral oil or suitable non-staining form coating compound, or shall be given two coats of nitrocellulose lacquer. All excess coating shall be removed by wiping with cloths. Reused forms shall have the contact surfaces cleaned thoroughly; those which have been coated shall be given an additional application of the coating.

7.4 Tolerances and Variations: The Contractor shall set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will exceed any of the tolerances specified in ACI 347.

8. MEASUREMENT AND MIXING:

8.1 General: Materials shall be measured, batched, and mixed in stationary or truck mixers as specified in ASTM C94. Concrete may be ready-mixed except as modified herein, or may be mixed on the site at the option of the Contractor. Proportioning of materials shall be accomplished by weighing.

8.2 Job Mixed Concrete: Concrete mixed at the job site shall be mixed in an approved type batch mixer in the manner specified for stationary mixers in ASTM C94.

8.3 Ready-mixed concrete: Except for the materials and placing times herein specified, ready-mixed concrete shall be mixed and delivered to the project in accordance with ASTM C94, using Alternate No. 2 for the mix design. With each load of concrete delivered to the project, the ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

9. PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS:

9.1 General Requirements: All reinforcement shall be provided with all necessary wire ties, chairs, spacers, supports, and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from flaky rust, scale, oil, grease, clay, and other coatings, and foreign substances that would reduce or destroy the bond. All reinforcement shall be supported and wired together to prevent displacement by construction loads or by the placing of concrete. Unless directed otherwise by the Contracting Officer, reinforcement shall not be bent after being partially embedded in hardened concrete. Where cover over reinforcing steel is not specified it shall be in accordance with ACI 318.

9.2 Placing reinforcement: Reinforcement shall be placed accurately and secured. It shall be supported by suitable chairs or spacers or by metal hangers. On the ground, and where otherwise subject to corrosion, concrete or other suitable non-corrodible material shall be used for supporting reinforcement. Welded wire fabric used as structural reinforcement in slabs shall be supported and adequately secured as required for reinforcing steel. Welded weir fabric shall be extended through contraction joints and construction joints.

9.3 Splicing of Reinforcement: Splicing of reinforcement shall be in accordance with ACI 318, except as indicated otherwise or modified herein. Sides and ends of welded wire fabric shall be overlapped not less than one mesh.

9.4 Setting Miscellaneous Materials: Anchors and bolts, including but not limited to those for machine and equipment bases; frames or edgings, hangers and inserts, pipe supports, pipe sleeves, metal ties, conduits, drains, and all other materials in connection with concrete construction; shall, where practicable, be placed and secured in position when the concrete is placed. Anchor bolts for machines shall be set to templates, shall be plumbed carefully and checked for location and elevation with an instrument, and shall be held in position rigidly to prevent displacement while concrete is being placed.

9.5 Waterstops: The material, design, and location of waterstops in construction joints and expansion joints shall be as indicated or as specified hereinbefore. Each piece of premolded waterstop shall be of maximum practicable length in order that the number of end joints will be held to a minimum. Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective watertightness fully equal to that of the continuous waterstop material and shall permanently develop not less than 50 percent of the mechanical strength of the parent section and shall permanently retain its flexibility.

9.6 Place rigid perimeter insulation and vapor barrier as indicated prior to placing concrete floor slabs on grade. Perimeter insulation shall be butted together and joints in vapor barrier shall be lapped 4 inches.

10. CONVEYING AND PLACING CONCRETE:

10.1 Conveying: Concrete shall be deposited as nearly as practicable in its final position in the forms. At any point in the conveying, the free vertical drop of the concrete shall not exceed 3 feet. Conveying equipment shall be cleaned thoroughly before each run. Concrete which has segregated in conveying shall be removed and disposed of as directed by the Contracting Officer.

10.2 Placing: No concrete shall be placed after there is evidence of initial set. The placement of concrete in uncovered areas during periods of precipitation will not be allowed. Placing concrete in water will not be allowed. Subgrades of earth or other material shall be properly prepared and, if necessary, covered with heavy building paper or other suitable material to prevent the concrete from becoming contaminated. Before placing concrete on porous subgrades, they shall be dampened as required to prevent water of hydration from being absorbed into the subgrade. Forms shall be clean of dirt, construction debris, water, snow, and ice. Concrete shall be deposited in approximately horizontal layers 12 to 20 inches deep in a manner to preclude the formation of cold joints between successive layers. The method of depositing concrete shall be such as to avoid displacing the reinforcement and segregating the aggregate. Concrete shall be worked about the reinforcement and embedded fixtures and into corners and angles of the forms, care being taken to avoid overworking which may result in segregation. Water which accumulates on the surface of the concrete during placing shall be removed by absorption with porous materials in a manner that prevents removal of cement. Pumping of concrete through aluminum pipe shall not be permitted.

10.3 Vibration: All concrete, with the exception of concrete slabs 4 inches or less in depth, shall be compacted with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Concrete slabs 4 inches or less in depth shall be consoli-

dated by wood tampers, spading and settling with a heavy leveling straight edge.

10.4 Expansion Joints and Embedded Items.

10.4.1 Expansion joints shall not be less than 1/2-inch wide except as indicated otherwise. Expansion joints not exposed to weather shall be filled completely with preformed joint material. Expansion joints exposed to weather shall be filled to a depth of 1-inch from the surface or face of the concrete with preformed joint material. The 1-inch deep space above the preformed material shall be cleaned after the concrete has been cured, and when dry, filled flush with joint sealing material.

10.4.2 Embedded Items: All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. All sub-contractors, whose work is related to the concrete or must be supported by it, shall be given ample notice and opportunity to introduce or furnish embedded items before the concrete is placed. All ferrous metal sleeves, inserts, anchors, and other embedded ferrous items exposed to the weather or where rust would impair the appearance or finish of the structure shall be galvanized. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Aluminum shall not be embedded in concrete except where aluminum is protected from direct contact with the concrete.

10.5 Placing Concrete in Cold Weather: Placing concrete in cold weather shall be in accordance with ACI 306 except as modified herein. Except when authorized specifically by the Contracting Officer, concrete shall not be placed when the atmospheric temperature is below 40 degrees Fahrenheit. When the concrete is likely to be subjected to freezing temperatures within 24 hours, concrete materials shall be heated, at no additional cost to the Government, so that the temperature of the concrete when deposited shall be between 65 and 80 degrees Fahrenheit. Methods of heating materials shall be subject to approval of the Contracting Officer. Water for mixing shall not be heated above 165 degrees Fahrenheit. Lumps of frozen material and ice shall be removed from the aggregates before placing them in the mixer. When approved by the Contracting Officer, not more than 2 pounds of type I or one pound ten ounces of type II calcium chloride conforming to O-C-105 may be used per bag of cement as an accelerator; however, calcium chloride shall not be used when the alkali content of the cement is greater than 0.6 percent. No extra payment will be made for the calcium chloride so used. It shall be applied in the mixer drum in the form of a solution; the water in the solution shall be included in the water-cement ratio of the concrete mixture. All other requirements given hereinbefore shall apply when calcium chloride is used. Concrete damaged by freezing shall be removed and replaced at no additional cost to the Government.

10.6 Placing Concrete in Hot Weather: Placing concrete in hot weather shall be in accordance with ACI 305 except as modified herein. In hot weather, extra care shall be taken to reduce the temperature of the concrete being placed, and to prevent rapid drying of newly placed concrete. When the outdoor ambient temperature is more than 90 degrees Fahrenheit, the temperature of the concrete as placed shall not exceed 90 degrees Fahrenheit; the fresh concrete shall be shaded as soon as possible after placing; and curing shall be started as soon as the surface of the fresh concrete is sufficiently hard to permit it without damage.

11. SURFACE FINISHES:

11.1 General Requirements: All formed surfaces shall be repaired by patching minor honeycombed or otherwise defective areas and tie holes with cement mortar. Cement mortar for patching shall be proportioned one part cement to two parts fine sand. Patching shall be done as soon as the forms are removed; areas of surfaces which are to be cured with a curing compound shall be covered during the application of the compound. All areas to be patched shall be cleaned thoroughly. The area to be patched and at least 6 inches adjacent thereto shall be saturated with water before placing the mortar. Patches on exposed surfaces shall be finished to match the adjoining surfaces. Patches shall be cured as specified for the concrete.

11.2 Standard Finish: Standard finish shall be provided for all exposed concrete not indicated or specified otherwise. The surface of the concrete shall not vary more than 1/4 inch when measured from a five foot template. Exposed surfaces shall be uniform in appearance.

11.2.1 Against Forms: All fins and other projections shall be removed carefully, and all abrupt irregularities shall be leveled. Surface pits having a dimension greater than 1/8-inch shall be filled with cement mortar as specified hereinbefore for patching.

11.2.2 Not Against Forms: Surfaces not specified otherwise shall be finished with wood floats to even surfaces.

12. CURING AND PROTECTION:

12.1 General Requirements: Concrete shall be protected adequately from injurious action by sun, rain, flowing water, frost, and mechanical injury, and shall not be allowed to dry out from the time it is placed until the expiration of the minimum curing periods specified hereinafter. Curing shall be accomplished by moist curing, impervious-sheeting curing, or by application of liquid membrane-forming compound. Membrane-forming compound shall not be used on concrete to which other concrete is to be bonded. Completion of curing shall be initiated immediately following the removal of forms. The temperature of the air next to the concrete shall be maintained at not less than 40 degrees Fahrenheit for the full

curing periods. When concrete is authorized for placement in temperatures below 40 degrees Fahrenheit, the air in contact with the concrete shall be maintained at a temperature of not less than 50 degrees Fahrenheit for a period of 7 days after placing, or at not less than 70 degrees Fahrenheit for a period of 3 days after placing, and at not less than 40 degrees Fahrenheit for the remainder of the specified curing periods. Heating of the concrete in place shall be effected by vented heaters or steam coils under canvas covers or by other suitable means. The temperature within enclosures shall not exceed 100 degrees Fahrenheit, and adequate moisture shall be applied to the concrete surface during the heating period to prevent it from drying out. The rate of cooling after the protection period shall be approximately one degree Fahrenheit per hour for the first 24 hours and two degrees Fahrenheit per hour thereafter. Concrete shall be protected against freezing for the full curing period specified hereinafter.

12.2 Moist Curing:

12.2.1 Mats: The entire surface of the concrete shall be covered with two thicknesses of wet burlap or other suitable material having high absorptive quality. The material shall be thoroughly wet when applied and shall be kept continuously wet during the time it remains on the slab. Mats shall be left in place not less than 72 hours.

12.2.2 Impervious Sheeting Curing: The entire exposed surface shall be wetted thoroughly with a fine spray of water and then covered with (a) waterproofed paper, (b) polyethylene-bonded waterproof paper sheeting, (c) polyethylene-coated burlap sheeting, or (d) polyethylene sheeting. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

12.3 Liquid Membrane-Forming Compound Curing: Liquid membrane-forming compound shall be applied over all concrete surfaces. All joint openings except sawed joints shall be sealed at the top by inserting moistened paper or fiber rope, or covering with strips of waterproof material, prior to application of the curing compound, in a manner to prevent the curing compound from entering the joint. Seven days following the placing of the liquid membrane-forming compound shall be considered as the end of the curing period and the basis for determining when joint sealing material will be placed in the joints. The curing compound shall be spray applied in two coats and in strict accordance with the manufacturer's printed instructions.

12.3.1 Protection of Treated Surfaces: Concrete surfaces to which liquid membrane-forming compounds have been applied shall be kept free from all foot and vehicular traffic and all other sources of abrasion for not less than 72 hours. Continuity of the coating shall be maintained for the entire curing period and any damage to the coating during this period shall be repaired immediately.

12.4 Curing Periods: The curing period for all concrete shall be at least 7 days.

12.5 Removal of Forms: Forms shall be removed in a manner which will prevent damage to the concrete. Forms shall not be removed until at least 24 hours after completion of concrete placing.

13. MISCELLANEOUS CONSTRUCTION:

13.1 Pits and Trenches: Pits and trenches shall have the bottom slabs and walls keyed and bonded together properly. Where practicable, the bottom slabs and walls shall be placed integrally. Slabs forming covers for pits and trenches shall have openings formed to suit the installation of equipment and apparatus.

13.2 Concrete sidewalks, curbs, and curb-and-gutter.

13.2.1 Concrete sidewalks shall be not less than the thickness indicated. Concrete sidewalks shall have contraction joints every 5 linear feet, cut to a depth of 3/4 inch with a jointing tool. Contraction joints shall be cut after the surface has been finished. Transverse expansion joints shall be installed at all returns, driveways, and opposite expansion joints in curbs. Where curbs are not adjacent, transverse expansion joints shall be installed at intervals of approximately 50 feet. Expansion joints shall be made with preformed joint material. Sidewalks shall be screeded and wood float finished to produce a uniform gritty surface. Edges of the sidewalks and joints shall be edged with a tool having a radius not greater than 1/8 inch. Sidewalks adjacent to curbs shall have a slope of 1/4 inch per foot toward the curb. Sidewalks not adjacent to curbs shall have a transverse slope of 1/4 inch per foot. The surface of the concrete shall show no variation in cross section in excess of 1/4 inch in 5 feet.

13.2.2 Concrete curbs and curb-and-gutter shall be constructed as indicated. At the option of the Contractor, the curbs and curb-and-gutter may be precast or cast in place. If cast in place, contraction joints similar to those specified for concrete sidewalks shall be provided at intervals of from 8 to 10 feet. If precast, the curbs and curb-and-gutter shall be given a steel trowel finish.

13.3 Splash Blocks: Splash blocks shall be provided at outlets of downspouts emptying at grade; they shall be of precast concrete, 24-inches long, 12-inches wide, and 6-inches thick, with countersunk dishes finished smooth and sloped to drain away from the building. The earth shall be compacted to provide firm bases for the blocks.

13.4 Concrete grout fill shall conform to the requirements of this section.

14. SAMPLING AND TESTING:

14.1 Sampling:

14.1.1 Concrete: Samples of wet concrete shall be collected during each working day as often as required to perform all tests required herein. Test specimens shall be made in accordance with ASTM C31. Sampling fresh concrete shall be in accordance with ASTM C172. Concrete samples shall be of proper size to permit making the required test specimens.

14.2 Testing:

14.2.1 Cement testing: Tests on cement will be waived and mill certificates will be acceptable.

14.2.2 Concrete Testing:

14.2.2.1 Testing consistency of concrete slump shall be determined in accordance with ASTM C 143. Tests shall be made at the beginning of a concrete placement operation and each time test cylinders are made.

14.2.2.2 Compressive Tests: Unless otherwise specified, testing of specimens for compressive strength shall be in accordance with ASTM C 39. Three tests specimens shall be made for each set of tests. Tests will be made at 7 and 28 days from time of molding. One specimen shall be tested at 7 days, and the other two at 28 days. When a satisfactory relationship between 7 day and 28 day strengths has been established, the 7 day test results may be used as an indicator of the 28 day strength. Each strength test for 28 day strength shall be the average of the strengths of the two test specimens of a set. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified 28 day compressive strength, and no individual strength test falls below the required 28 day compressive strength by more than 500 pounds per square inch. Where strength level of concrete falls below the specified limits, the Government may order core samples taken, and tested, at the Contractor's expense. In such event, three core samples for each cylinder test indicating defective concrete shall be taken for further testing. Sampling, testing, and evaluation of drilled cores shall be in accordance with ACI 318, Part 3, Chapter 4. Concrete which is determined to be defective based on the strength acceptance criteria therein shall be removed and replaced with acceptable concrete, at no additional cost to the Government. Frequency of compressive tests on concrete cylinders shall be as follows:

a. Not less than 6 test cylinders for each 150 cubic yards, or fraction thereof, of each class of concrete placed, and

b. Not less than 3 test cylinders for each day for each class of concrete placed that day

c. Space testing so that no more than 3 of the test cylinders are taken from any one batch.

14.2.2.3 Air Content: Air-entrained concrete shall be tested for air content at the same frequency as specified for slump tests.

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DIVISION 4. MASONRY

SECTION 04200. CONCRETE MASONRY UNIT WORK

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

1.1 American Society for Testing and Materials (ASTM) Publications:

A82-76A	Cold-Drawn Steel Wire for Concrete Reinforcement.
A90-69(1973)	Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
A153-73	Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
A615-75	Deformed Billet Steel Bars for Concrete Reinforcement.
A616-76A	Rail Steel Deformed Bars for Concrete Reinforcement.
C90-75A	Hollow Load-Bearing Concrete Masonry Units.
C91-75	Masonry Cement.
C129-75	Hollow Non-load Bearing Concrete Masonry Units.
C144-70(1975)	Aggregate for Masonry Mortar.
C145-75A	Solid Load-Bearing Concrete Masonry Units.
C150-76A	Portland Cement.
C207-76A	Hydrated Lime for Masonry Purposes.
C270-73	Mortar for Unit Masonry.
D476-71	Mortar and Grout for Reinforced Masonry.

2. QUALITY CONTROL:

2.1 General: The Quality Control provisions of Division 1, General Requirements, apply to this section. Approvals, except those required for field installations, field applications and field tests, shall be obtained before delivery of materials or equipment to the project site.

2.2 Tests and Samples:

2.2.1 Efflorescence Tests: Efflorescence tests shall be made on concrete masonry units, and mortar materials which will be exposed to weathering. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting, if necessary.

2.2.1.1 Concrete Masonry Units: Ten unbroken masonry unit specimens shall be selected in 5 pairs, each pair of similar appearance. One unit of each pair shall be tested by placing it on end in a glass or glazed receptacle in which one inch depth of distilled water is maintained. After being indoors at normal temperatures for 7 days, the masonry unit shall be removed from the water and air dried for 24 hours. Each pair of units shall be removed from the water and if the difference due to efflorescence is noticeable on any of the five samples,

when viewed at a distance of 10 feet, the units represented by the samples will be rejected.

2.2.1.2 Mortar: A 3 ounce mortar specimen shall be prepared of each proposed mix, using as little water as possible. While still in a plastic condition and prior to its initial set, each mortar specimen shall be placed in a glass or glazed receptacle, and four ounces of distilled water shall be mixed with the mortar and stirred thoroughly for 5 minutes. The receptacle shall be of such a size that when the mortar specimen and water are combined in solution, and a masonry unit is placed in it, the solution will have a depth of 1/2 to one inch. A masonry unit, which has been tested and found free of efflorescence, shall be placed on end in the solution and the water level maintained at 1/2 to one inch with distilled water. After being indoors at normal temperature for 7 days, the masonry unit shall be removed from the solution and air dried for 24 hours. The masonry unit shall be compared with an untreated unit, and if the difference due to efflorescence is noticeable, when viewed at a distance of 10 feet, the mortar components shall be tested in separate receptacles, each containing a masonry unit which has been tested and found free of efflorescence. Each mortar component shall be thoroughly mixed with 4 ounces of distilled water, using one ounce of each cementitious material and 3 ounces of each aggregate, and the water level shall be maintained at a depth of 1/2 to one inch with distilled water. After 7 days indoors at normal temperatures, the masonry units shall be removed from the solution and observed for efflorescence, as specified hereinbefore, and the component causing efflorescence will be rejected.

3. SUBMITTALS:

3.1 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:

Prepackaged Mortar Mix	Flashing	
Concrete Masonry Units	Anchors	
Reinforcement	Coatings	Ties

3.1.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specifications"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference specifications listed:

MANUFACTURER AND PRODUCT

Ultra Cement Company
Miracle Mortar Mix

REFERENCE SPECIFICATION

ASTM C270, Type S, air content
not more than 16 percent.

SIGNATURE AND TITLE

3.2 Catalog Data: Submit complete descriptive literature for each type of each of the following items. Data which describe more than one type, size, model, or items shall be clearly marked to indicate which type, size, model, or item the Contractor intends to provide. Data shall be sufficient to show conformance to specified requirements and shall include installation drawings and instructions.

Prepackaged Mortar Mix
Concrete Masonry Units
Reinforcement

Flashing
Anchors
Coatings

Ties

3.3 Materials Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet the testing requirements specified and that the tested material is of the same type, quality, manufacture and make as that furnished for this project. Copies of the test reports shall not be submitted, except as specifically requested by the Contracting Officer.

4. DELIVERY AND STORAGE: Cement, lime and other cementitious materials shall be delivered to the site and stored in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar materials shall be stored in dry, weathertight sheds or enclosures, and shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly distributed loading does not exceed 50 psf. Masonry materials shall be protected from contact with earth and exposure to the weather, and shall be kept dry until used. Materials containing frost or ice shall not be used.

5. MATERIALS: The source of supply for materials which will affect the appearance of the finished work shall not be changed after the work has started.

5.1 Concrete Masonry Units: Of modular dimensions, and shall be either air, water, or steam cured. Type II units shall be stored at the site before use, a minimum of 28 days for air cured units; 10 days for

steam or water cured units; and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours. Exposed surfaces of units shall be comparatively smooth and of uniform texture.

5.1.1 Hollow Load-Bearing Units: ASTM C90; grades N-I or N-II.

5.1.2 Hollow Non-Load-Bearing Units: Types I or II conforming to ASTM C129, shall be provided for interior non-load-bearing walls and partitions, except that load-bearing units may be provided in lieu of non-load-bearing units.

5.1.3 Concrete Building Brick: ASTM C55, Grades S-I or S-II except that brick exposed to weather shall be Grades N-I or N-II. Concrete brick shall match the concrete masonry units with which they are used as closely as practicable in color and surface characteristics.

5.1.4 Solid Load-Bearing Units: ASTM C145, grades S-I or S-II, except that units exposed to weather shall be grades N-I or N-II. Solid units shall be provided for masonry bearing under structural framing members.

5.1.5 Special Shapes: Special shapes, such as closures, header units, and jab units, shall be provided as necessary to complete the work, and shall conform to the applicable portions of the specifications for the units with which they are used.

5.2 Mortar for Concrete Masonry Unit Work: ASTM C270 except that the air content shall not exceed 16 percent when tested in accordance with ASTM C91. Mortar for foundation walls shall be Type M. Mortar for other work shall be Type S. All the materials required for the mortar, except aggregate and water, may be combined in a prepackaged mortar mix. Containers of prepackaged mortar mix shall be provided with printed instructions on proportions of water and aggregate to be used and mixing requirements necessary to obtain the type mortar required.

5.3 Portland Cement: Type I, conforming to ASTM C150.

5.4 Hydrated Lime: Type S, conforming to ASTM C207.

5.5 Sand: Sand shall conform to ASTM C144.

5.6 Water: Water for mixing shall be potable.

5.7 Horizontal Joint Reinforcement: Fabricated from cold drawn steel wire, conforming to ASTM A82. The wire shall be zinc-coated after fabrication by the hot-dip process in accordance with ASTM A153 zinc-coated after fabrication. Reinforcement shall consist of two or more parallel longitudinal wires, not less than 0.1620 inch in diameter, weld connected with cross wires, not less than 0.1055 inch in diameter. The out-to-out

spacing of the longitudinal wires shall be 1-1/2 to 1-3/4 inches less than the actual width of the masonry. The distance between welded contacts of cross wires with each longitudinal wire shall not exceed 16 inches. Joint reinforcement shall be provided in flat sections, not less than 10 feet in length, except that corner reinforcements and other special shapes may be less in length.

5.8 Anchors and Ties: Of approved designs, and shall be of copper-clad steel, zinc-coated steel, or non-corrosive metal having the equivalent total strength of steel types. Zinc-coated items shall be coated by the hot-dip process after fabrication. Zinc-coated items shall have a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A90.

5.8.1 Corrugated Metal Ties: Not less than 7/8 inch wide by approximately 7 inches long, and not lighter than 18 gage.

5.8.2 Rigid Steel Anchors: Not less than one inch wide, 1/4 inch thick, and 24 inches long between bent ends. Each end shall be bent down not less than 3 inches into the mortar-filled cells.

5.8.3 Anchors Used with Embedded Slots or Inserts: Dovetail type, of sheet steel, not lighter than 16 gage and one inch wide, and shall be crimped, corrugated, or bent at the end to provide adequate anchorage; anchors for wire inserts shall be of 9 gage wire, looped and closed. Anchors shall be of the proper length for the use intended. Dovetail slots and inserts are specified under another section.

5.9 Reinforcing Steel Rods: ASTM A615 or A616.

6. INSTALLATION:

6.1 Environmental Conditions: Masonry shall not be laid when the air temperature is below 40 degrees F on a falling thermometer, or when it appears probable that temperatures below 40 degrees F will be encountered before the mortar has set, unless adequate means are provided for protecting the work from freezing. Protection shall consist of heating and maintaining the temperature of the masonry materials at not less than 40 degrees F, but not more than 160 degrees F and maintaining an air temperature above 40 degrees F on both sides of the masonry for not less than 72 hours. Work will not be permitted with or on frozen materials. Masonry work may be started at 34 degrees F on a rising thermometer.

6.2 Workmanship: Masonry wall shall be carried up level and plumb all around. One section of the walls shall not be carried up in advance of the others. Unfinished work shall be stepped back for joining with new work; tothing will not be permitted. Heights of masonry shall be checked with an instrument at each floor, and at sills and heads of openings, to maintain the level of the walls. Door frames, louvered openings, anchors, pipes, ducts, and conduits shall be built in carefully

and neatly as the masonry work progresses. Spaces around metal door frames shall be filled solidly with mortar. Masonry units shall be handled with care to avoid chipping, cracking, and spalling of faces and edges. Drilling, cutting, fitting, and patching, to accommodate the work of others, shall be performed by masonry mechanics. Masonry shall be cut with masonry saws in exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork specified elsewhere shall be placed in position as the work progresses. Chases of approved dimensions for pipes and other purposes shall be provided where indicated or necessary. Tops of exposed walls, not being worked on, shall be covered with a waterproof membrane, well secured in place. Unless indicated otherwise, partitions shall extend from the floor to the roof construction above. Walls and partitions shall be structurally bonded or anchored to each other. Scaffolding shall be inspected regularly, and shall be amply strong, well braced, and securely tied in position. Overloading of scaffolding will not be permitted.

6.3 Mortar Mixing: Mortar materials shall be measured in proper containers that will insure that the specified proportions of materials will be controlled and accurately maintained during the progress of the work. Measuring materials with shovels will not be permitted unless specified otherwise, mortar shall be mixed in proportions by volume. The aggregate shall be introduced and mixed in such a manner that the materials will be distributed uniformly throughout the mass. A sufficient amount of water shall be added gradually and the mass further mixed, not less than 3 minutes, until a mortar of the plasticity necessary for the purposes intended is obtained. The mortar shall be machine-mixed in suitable mixers, of the type in which the quantity of water can be controlled accurately and uniformly. Mortar boxes, pans and mixer drums shall be kept clean and free of debris of dried mortar. The mortar shall be used before the initial setting of the cement has taken place; retempering of mortar in which cement has started to set will not be permitted. Antifreeze compounds, salts, or any other substance used to lower the freezing point of mortar will not be permitted.

6.3.1 Mortar for Concrete Masonry Unit Work: Mortar shall be mixed at the site using materials conforming to ASTM C270 necessary to obtain type mortar required. Measurement and mixing shall conform to ASTM C270. When prepackaged mortar mixes are used, the mixing shall conform to the printed instructions of the prepackaged mortar mix manufacturer.

6.3.2 Grout: ASTM C476. Fine grout shall be provided in grout spaces less than 2 inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Coarse grout shall be provided in grout spaces 2 inches or greater in all horizontal dimensions and clearance between reinforcing and masonry is not less than 3/4 inch.

6.4 Mortar Joints: Mortar joints shall be uniform in thickness, and the average thickness of any three consecutive joints shall be 3/8 to 1/2 inch, unless otherwise specified. "Story poles" or "gage rods" shall be made by the Contractor prior to starting the work. They shall be used prior to starting the work, and shall be used throughout the work. Changes in coursing or bonding after the work is started will not be permitted. Exposed joints shall be tooled slightly concave with a round or other suitable jointer when the mortar is thumbprint hard. The jointer shall be slightly larger than the width of the joint, so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Joints in masonry that will not be exposed shall be struck flush. Horizontal joints shall be tooled first. Joints shall be brushed to remove all loose and excess mortar. All horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch.

6.5 Concrete Masonry Unit Work: The first course of concrete masonry units shall be laid in a full bed of mortar for the full width of the unit; the succeeding courses shall be laid with broken joints. The bed-joints of concrete masonry unit shall be formed by applying the mortar to the entire top surfaces of the inner and outer face shells, and the head joints shall be formed by applying the mortar for a width of about one inch to the ends of the adjoining units laid previously. The mortar of joints shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of the joints as the units are being placed in position. Where anchors, bolts, and ties occur within the cells of the units, such cells shall be filled with mortar or grout as the work progresses. Concrete brick shall be used for bonding walls, working out the coursing, topping out walls under sloping slabs distributing concentrated loads, backing brick headers, and elsewhere as required. Concrete masonry units shall not be dampened before or during laying.

6.5.1 Reinforced Concrete Masonry Unit Walls: Reinforced concrete masonry unit walls shall be laid in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Cross webs adjacent to vertical cores that are to be filled with grout shall be fully embedded in mortar, to prevent leakage of grout. Mortar fins protruding from joints shall be removed before grout is placed; the minimum clear dimensions of vertical cores shall be 2 inches by 3 inches. Reinforcing shall be positioned accurately as indicated. As masonry work progresses, vertical reinforcing shall be rigidly secured in place at vertical intervals not to exceed 160 bar diameters. Horizontal reinforcing shall be embedded in grout as grouting proceeds. The minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, splices shall be formed by lapping bars not less than 20 bar diameters and wire tying them together.

6.6 Bonding and Anchoring: Bonding and anchoring masonry walls and partitions shall be securely anchored or bonded at points where they intersect and where they abut or adjoin the concrete frame of a building. All anchors shall be completely embedded in mortar.

6.6.1 Corners and Intersections of Load-Bearing Masonry Walls: Corners and intersections of load-bearing masonry walls shall be bonded in each course with a true masonry bond, except where indicated or specified otherwise.

6.6.2 Intersecting Bearing Walls: Intersecting bearing walls which are erected separately shall be anchored with rigid steel anchors spaced not more than 2 feet apart vertically.

6.6.3 Intersections of Non-Load-Bearing Partitions with other Walls or Partitions: Intersections of non-load-bearing partitions with other walls or partitions shall be tied with corrugated metal anchors at vertical intervals of not more than 2 feet, or with masonry bonding in alternate courses.

6.6.4 Masonry Walls Facing or Abutting Concrete Members: Masonry walls facing or abutting concrete members shall be anchored to the concrete with dovetail or wire type anchors inserted in slots or inserts built into the concrete. Anchors shall be spaced not more than 18 inches on centers vertically and not more than 24 inches on centers horizontally.

6.7 Horizontal Joint Reinforcement: Welded wire tie reinforcement shall be provided where indicated and in every other course and in the other two courses above and below openings of concrete masonry units and in concrete masonry unit walls and partitions. Reinforcement shall be continuous, except that it shall terminate on each side of control joints. Reinforcement above the below openings shall extend not less than 24 inches beyond each side of openings. Reinforcement shall be provided in the longest available lengths, utilizing the minimum number of splices. Splices shall overlap not less than 12 inches. Welded "L"-shape assemblies, not less than 40 by 48 inches, and "T"-shaped assemblies, not less than 32 by 32 inches, both of the same size members and the same construction as the straight reinforcement, shall be provided at corners and intersections of walls and partitions. Reinforcement shall be embedded in the mortar joints in such manner that all parts will be protected by mortar.

6.8 Concrete Masonry Unit Lintels and Bond Beams: Concrete masonry unit lintels and bond beams shall be formed of units having the cells filled solidly with grout or concrete, and reinforced as indicated. Reinforcing shall overlap a minimum of 24 bar diameters at splices; bond beams and reinforcing shall be broken at expansion joints. Concrete masonry units used for lintels and bond beams shall be of special shapes, and exposed work shall be of the same material and texture as the adjoining

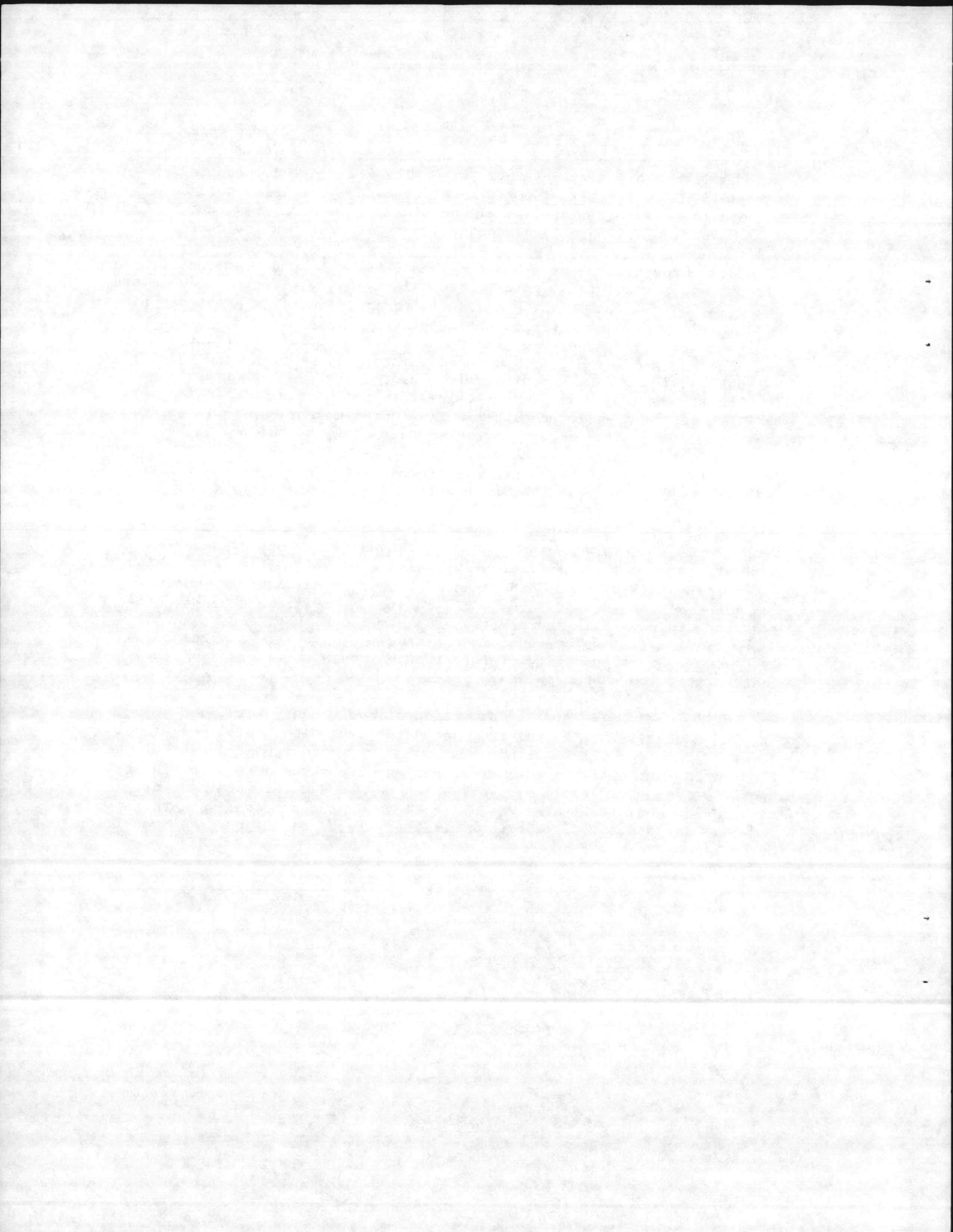
masonry units. Lintels shall be built on the ground and allowed to set at least 6 days before being moved, and they shall be straight and true and shall have at least 6 inches of bearing at each end. In lieu of formed-in-place lintels, precast concrete masonry lintels shall be acceptable. Precast lintels shall be minimum compressive strength of 3,000 pounds per square inch and shall be reinforced as indicated.

6.9 Grout Placement: Grouting shall be performed from the interior side of walls, except as approved otherwise. Sills, ledges, offsets and other surfaces to be left exposed shall be protected from grout droppings; grout falling on such surfaces shall be removed immediately. Grout shall be well stirred before placing to avoid segregation of the aggregate and shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids. Grout shall be placed, by pumping or pouring from buckets equipped with spouts, in lifts not exceeding 2 feet; pours shall be kept at 1-1/2 inches below the top of masonry units in top course, except at the finish course. Grout shall be puddled or agitated thoroughly to eliminate voids without displacing masonry from its original position; masonry displaced by grouting operation shall be removed and laid in realignment with fresh mortar.

6.10 Forms and Shoring: Forms and shoring for reinforced masonry members shall conform to the shape, lines and dimensions of members indicated and shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry. Curing shall be maintained, and forms shall remain on girders and beams not less than 10 days after completion of the members. Not less than 16 hours shall elapse before uniform construction loads are applied to completed masonry members; not less than 64 hours shall elapse before concentrated loads are applied.

6.11 Cleaning: At the completion of the masonry work, holes in exposed masonry shall be pointed, and defective joints shall be cut out and tuck pointed solidly with mortar. Exposed masonry surfaces shall be cleaned to remove all excess mortar and as necessary to receive finishes specified in other sections. Work which may be damaged, stained, or discolored, shall be protected during the cleaning process; work that is damaged, stained, or discolored shall be restored to its original condition or replaced.

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DIVISION 5. METALS, STRUCTURAL & MISCELLANEOUS

SECTION 05120. STRUCTURAL STEEL

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

1.1 Federal Specifications:

TT-C-490B	Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.
TT-P-645	Primer, Paint, Zinc-Chromate, Alkyd Type.
TT-V-51f	Varnish; Asphalt.

1.2 Military Specifications:

MIL-P-15328C & Am 1	Primer (Wash), Pretreatment Blue, (Formula No. 117-B for Metals).
MIL-P-21035 & Am 1	Paint, High Zinc Dust Content, Galvanizing Repair.

1.3 American Institute of Steel Construction (AISC):

Code of Standard Practice for Steel Buildings and Bridges, dated Sept. 1, 1976

Manual of Steel Construction - 7th Edition, including Supplements 1, 2, and 3.

1.4 American National Standards Institute (ANSI):

B18.22.1-1965 (R 1975)	Plain Washers.
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1.5 American Society for Testing and Materials (ASTM):

A36-74a	Structural Steel
A123-73	Zinc (Hot-galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.
A153-73	Zinc Coating (Hot Dip) on Iron and Steel Hardware.
A307-76B	Carbon Steel Externally and Internally Threaded Standard Fasteners.
A325-76C	High-Strength Bolts for Structural Steel Joints including Suitable Nuts and Plain Hardened Washers.

A490-77

Quenched and Tempered Alloy Steel Bolts for
Structural Steel Joints.

1.6 American Welding Society (AWS):

D1.1-75 (with
1976 & 1977
Revisions) Structural Welding Code.

1.7 Corps of Engineers Publication:

CRD-C588-76 Nonshrink Grout

1.8 Research Council on Riveted and Bolted Structural Joints of the
Engineering Foundation (RCRBSJ) Publication:

Specification for Structural Joints Using ASTM
A325 or A490 Bolts, dated Feb. 4, 1976.

1.9 Steel Structures Painting Council (SSPC) Publications:

SP3-63 Surface Preparation Specification No. 3,
Power Tool Cleaning.

SP6-63 Surface Preparation Specification No. 6,
Commercial Blast Cleaning.

2. SUBMITTALS:

2.1 Shop Drawings: Submit shop drawings of all structural steel for approval prior to fabrication of structural steel. Include complete information necessary for the fabrication and erection of the component parts of the structure, including the location, type and size of all bolts and welds. Include all welds by standard welding symbols of the AWS.

2.2 Certificates of Conformance or Compliance: Submit certificates of conformance for the following:

- a. Common Bolts.
- b. Welding Electrodes and Rods
- c. Paint.
- d. Galvanizing Repair Compound.
- e. Zinc-Coating Processes for hardware and for steel products.
- f. Non-Shrink Grout.
- g. Steel.
- h. High-Strength Bolts and Nuts.

3. DELIVERY AND STORAGE: Materials shall be handled, shipped, and stored in a manner that will prevent distortion or other damage.

Material shall be stored in a clean, properly drained location out of contact with the ground. All damaged material shall be replaced or repaired in an approved manner by and at the expense of the Contractor.

4. MATERIALS: Unless otherwise specified, materials shall conform to the applicable requirements of the AISC "Manual of Steel Construction".

4.1 Carbon Steel for all-purpose bolted or welded construction shall conform to ASTM A 36.

4.2 Circular Washers for Common Bolts shall conform to ANSI B18.22.1, Type A.

4.3 Beveled Washers for American Standard Beams and Channels shall be square or rectangular, shall taper in thickness, and shall be smooth.

4.4 High Strength Steel Bolts and Nuts shall conform to ASTM A325 or A490.

4.5 Circular Washers for High Strength Bolts shall conform to ASTM A325.

4.6 Welding Electrodes and Rods shall conform to AWS D1.1.

4.7 Zinc Coating: Zinc-coated steel shall conform to ASTM A123. Zinc coating for threaded products shall conform to ASTM A153.

4.8 Non-shrinking Grout shall be a standard commercial grouting mortar containing a chemical oxidizing agent.

5. FABRICATION:

5.1 General: Fabrication shall be in accordance with the applicable provisions of the AISC "Manual of Steel Construction". Workmanship shall be equal to standard commercial practice in modern structural shops. Fabrication and assembly shall be done in the shop to the greatest extent possible. Holes shall be provided where necessary to secure other work to structural steelwork.

5.2 Welding of structural steelwork shall be in accordance with AWS D1.1.

5.3 High Strength Steel Bolts: The design and assembly of structural joints using high-strength steel bolts shall be according to the RCRBSJ specification for "Structural Joints using ASTM A325 or A490 bolts".

5.4 Shop Painting: Except as otherwise specified, all structural steelwork, except zinc-coated surfaces and steel work to be embedded in concrete or mortar, shall be shop painted. Surfaces to be welded shall not be coated within three inches of the weld, prior to welding. Surfaces

shall be thoroughly dry and clean when the paint is applied. No painting shall be done in freezing or wet weather except under cover; the temperature shall be above 45 degrees F but not over 90 degrees F. Paint shall be applied in a workmanlike manner, and all joints and crevices shall be coated thoroughly. Surfaces which will be concealed or inaccessible after assembly shall be painted prior to assembly.

5.4.1 Cleaning: Except as modified herein, surfaces shall be cleaned to bare metal by an approved blasting process. Surfaces that may be damaged by blasting shall be cleaned to bare metal by powered wire brushing or other mechanical means. Except for floating structures, surfaces which will be enclosed from the weather and subject to exposure no more corrosive than an indoor atmosphere controlled for human comfort, may be cleaned by wire brushing or other manual or mechanical means for removal of loose mill scale, rust, dirt, and other deleterious substances. Cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Bearing surfaces, including contact surfaces within friction-type joints, shall not be painted or galvanized but shall be coated with an approved rust preventive, applied in the shop. The coating shall be removed just prior to field erection using a removal approved by the rust preventive manufacturer. The surfaces, when assembled, shall be free from rust, grease, dirt and other foreign matter.

5.4.2 Pretreatment: Immediately after cleaning, surfaces shall be coated with a coat of pretreatment coating conforming to specification MIL-p-15328 applied to a dry film thickness of 0.3 to 0.5 mil or be given a crystalline phosphate base coating conforming to specification TT-C-490, method I, except that the phosphate base coating shall be applied only to blast cleaned, bare metal surfaces. Pretreatment may be omitted when red lead paint conforming to Type I of specification TT-P-86 is used.

5.4.3 Priming: Treated surfaces shall be primed as soon as practicable after the pretreatment coating has dried. Except as modified herein, the primer shall be a coat of zinc chromate primer conforming to specification TT-P-645 or a coat of red lead paint, type I or type III, conforming to specification TT-P-86, applied to a minimum dry film thickness of 1.0 mil. Surfaces that will be concealed after construction and will require no over-painting for appearance may be primed with a coat of asphalt varnish conforming to specification TT-V-51 applied to a minimum dry film thickness of 1.0 mil. Damage to primed surfaces shall be repaired with primer.

5.5 Repair of Zinc-coating: All zinc-coating that has been damaged in handling or transporting or in welding, riveting, or bolting shall be repaired by the application of a galvanizing repair paint conforming to specification MIL-P-21035. Areas to be repaired shall be cleaned and the slag removed from the welds. Surfaces to which the repair paint is applied, shall not be heated.

5.6 Match Marking: Members and component parts of structures shall be assembled and match marked prior to erection to insure accurate assembly and adjustment of position on final erection. Painted assembly markings shall be remote from any surface to be welded or riveted. Scratch or notch marks shall be located in a manner that will not affect the strength of the member or cause concentrations of stress.

6. ERECTION:

6.1 General: Except as modified herein, erection shall be in accordance with the AISC "Manual of Steel Construction". Erecting equipment shall be suitable for the work and shall be in first class condition. Where parts cannot be assembled or fitted properly as a result or errors in fabrication or of deformation due to handling or transportation, such condition shall be reported immediately and approval of the method of correction obtained; the correction shall be made in the presence of the approving authority. The straightening of plates and angles or other shapes shall be done by approved methods. If heating of metal is approved for straightening, it shall not be to a higher temperature than that producing a dark "cherry red" color. After heating, the metal shall be cooled as slowly as possible. There shall be no evidence of fracture on the surface of the metal after straightening. The heating of heat-treated parts for straightening will not be permitted. Steelwork shall be drained properly; pockets in structures exposed to the weather shall be filled with an approved waterproof material. Safety belts and lines shall be used by workmen aloft on high structures, unless safe working platforms or safety nets are provided. Do not use impact wrenches to tighten anchor bolts set in concrete.

6.2 Connections: Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Connections for which details are not indicated shall be designed in accordance with AISC "Manual of Steel Construction".

6.3 Base Plates and Bearing Plates: Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned. The area under the plate shall be dry-packed solidly with a non-shrinking type of grouting mortar.

6.4 Tolerances: Erection tolerances shall be in accordance with the "Code of Standard Practice" of the AISC "Manual of Steel Construction", as modified herein. In addition to the requirements of the Code of Standard Practice, the displacement of the column centerline from the established column location shall not be more than 1/4 inch in any direction at the base of the column as measured in the plane of the footing.

6.5 Temporary welds and backing strips shall not be removed.

7. QUALIFICATION OF WELDERS: Welding shall be performed by qualified welders. The qualification of welders and the duration of qualification period shall be in accordance with the requirements of AWS D1.1. Any welder found to be producing unsatisfactory work even though he has passed qualification tests shall be immediately recertified or replaced with a qualified welder.

8. INSPECTION OF WELDS: Visual inspection of welding shall be made while the welders are making the welds and again after the work is completed for the penetration of the weld metal, fusion, and general ability of the operator. After the welding is completed, welds shall be hand or power wire brushed and thoroughly cleaned before the inspector makes the check inspection. The inspector shall pay particular attention to surface cracking, surface porosity, surface slag inclusions, undercut, overlap, gas pockets and size of weld. Defective weldings shall be corrected in accordance with the applicable requirements of AWS D1.1.

9. TESTING HIGH STRENGTH BOLTS: Test each high strength bolt connected as required by the RCRBSJ "Specification of Structural Joints Using ASTM A325 or A490 Bolts".

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SECTION 05500. METAL FABRICATIONS

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

1.1 Federal and Military Specifications:

QQ-A-200D	Aluminum Alloy, Bar, Rod, Shapes, Structural Shapes, Tube, and Wire Extruded; General Specification for.
QQ-A-250	Aluminum, and Aluminum Alloy Plate and Sheet; General Specification for.
QQ-S-698 & Am 3	Steel, Sheet and Strip, Low Carbon.
RR-F-621b	Frames, Covers, gratings, steps, sump and catch basin, manhole.
RR-G-661C	Gratings, Metal, Floor (Except for Naval Vessels).

1.2 American Society for Testing and Materials (ASTM):

A36-74	Structural Steel.
A53-73	Welded and Seamless Steel Pipe.

1.3 American Welding Society (AWS):

D1.1-1975 (with 1976 Revision)	Structural Welding Code.
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1.4 American Institute of Steel Construction (AISC):

Manual of Steel Construction (7th Edition).

2. QUALITY CONTROL: Approvals, except those required for field installations, field applications and field tests, shall be obtained before delivery of materials to the project site.

3. SUBMITTALS:

3.1 Materials Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified and that the tested material is of the same type, quality, manufacture and make as that tested. Copies of the test reports need not be submitted, except as specifically requested by the Contracting Officer.

3.2 Descriptive Data: Submit complete descriptive data on the following materials. Data shall be sufficient to show conformance to specified requirements. Furnish data on gratings.

3.3 Shop drawings for the following items shall be submitted and approved before delivery of such items to the site. The drawings shall show materials, connections, finish and all pertinent details. Shop drawings to be submitted shall include pipe railings, ladders, gratings, access hatch and frame for fill port containment basins.

4. DELIVERY, STORAGE, AND PROTECTION: Materials shall be delivered to the site in an undamaged condition. Materials shall be carefully stored off the ground to provide proper ventilation, drainage, and protection against dampness. Defective and/or damaged materials shall be replaced by the Contractor at no expense to the Government.

5. GENERAL: Fabrications shall be well constructed products conforming to the types, materials and details indicated or specified herein. Basic forms of metal components from which assemblies are fabricated shall be of wrought or cast metal as shown or specified and physical properties, including tempers, of the metal shall be suitable for their intended use. All metals shall be free of defects which will affect their strength or durability and where exposed to view in the finished work, edges, and surfaces shall be without burrs, gouges, scratches, or other blemishes which mar their appearance. Exposed welds and brazed or soldered joints shall be ground smooth; polished or other surfaces with applied finishes shall be protected against damage or defacement of any kind. Assemblies shall be of the manufacturer's standard construction except where indicated or specified otherwise. Permanent connections for components subject to impact or other live loads shall be effected by welding, riveting or other approved methods. Welding shall conform to AWS D1.1 and shall be accomplished so as to prevent permanent distortion of the connected parts. Bolts, screws and similar suitable fastenings shall be used for anchoring or securing miscellaneous metal work to supporting construction unless indicated otherwise. The Contractor shall verify all measurements and shall take field measurements before fabrication. Materials and parts to complete each item shall be included, even though such work is not definitely shown or specified. Miscellaneous bolts and anchors, supports, braces, and connections for completion of the miscellaneous metalwork shall be provided.

5.1 Fabrication and Installation: All miscellaneous metalwork shall be fabricated and installed in a first-class manner by experienced mechanics skilled in the trade and in accordance with the manufacturer's directions. All work shall be fabricated to allow for expansion and contraction of materials. Welding and brazing shall be of adequate strength and durability, with tight, flush joints, dressed smooth and clean. Build anchors and other connecting members which occur in concrete or masonry into the concrete or masonry as the work progresses, so as to avoid unnecessary cutting and drilling. Cut, fit and drill so that all materials are properly set in place and so as to permit engaging work to be properly installed.

5.2 Connections: Connections shall conform to the Minimum Standard Connections as indicated in AISC Steel Construction Manual, except as indicated or specified otherwise. When such standards are not applicable, all joints shall be continuous along entire line of contact, except where spot welding is indicated or permitted. Where exposed, welds shall be ground smooth; where bolted or riveted connections are indicated, such connections may be welded at the Contractor's option, but welds must be ground perfectly smooth. Threaded connections shall be made up tight so that threads are entirely concealed. Bolted work shall be made up tight and the threads nicked or the stem bushed to prevent loosening. Abutting bars shall be shouldered and headed, dowelled and pinned. Rivet, bolt and screw heads shall be flat and countersunk in exposed work and elsewhere as required. Removable members shall be carefully machined, fitted and secured by means of screws or bolts of proper size and approved spacing.

6. MATERIALS: Gages shown, indicated or specified here in are U.S. Standard for ferrous metals, and Brown and Sharp for nonferrous metals. Gages and thicknesses of material indicated or specified are minimum. Unless specified otherwise, materials shall be in accordance with the minimum specifications and standards as applicable:

<u>Material</u>	<u>Specification</u>
Structural steel - plates, shapes and tubes	ASTM A36
Carbon steel - bars, hot rolled	ASTM A576
Carbon steel - sheets and strips	QQ-S-698
Steel pipe - welded and seamless	ASTM A53
Aluminum alloy - extruded bars, shapes and tubes	QQ-A-200
Aluminum alloy - plates and sheets	QQ-A-250
Aluminum alloy castings	QQ-A-601

6.1 Protective coatings. All surfaces of ferrous metal, except zinc-coated and plated work and those surfaces to be embedded in concrete or mortar, shall be shop primed with one coat of zinc chromate primer conforming to TT-P-645. Nonferrous metal surfaces shall be protected by plating, anodic, organic or other coatings as specified herein. Where surfaces of dissimilar metals are contiguous or metals are in contact with an absorptive material such as wood, masonry, concrete stucco, or plaster, they shall be given a heavy brush coat of bituminous paint conforming to TT-V-51 or separated by a non-absorptive tape or gasket. Zinc chromate primer, conforming to TT-P-645, may be substituted for bituminous coating.

7. DETAIL REQUIREMENTS:

7.1 Fastenings: Anchors and bolts, in addition to those indicated shall be provided where required for securing the work in place. Sizes, types and spacings of anchors and bolts not indicated or specified

otherwise shall be suitable for their purposes. Anchors and bolts shall be of zinc-coated steel except those adjacent to nonferrous metals shall be of the same or approved metals compatible with the materials which they adjoin. All fastenings shall be concealed where practicable. Where exposed in finished surfaces, rivets, bolt and screw heads shall be Phillips slot, oval type, unless otherwise shown, specified or approved. Standard bolts and screws shall be used for attachment of work to structure. Where hollow concrete masonry units make the use of expansion bolts unsuitable, provide toggle bolts or other suitable fastening devices as approved. Wood plugs shall not be used in any material.

7.2 Inserts and sleeves: Inserts of suitable and approved types shall be provided for the support or anchorage of equipment and finish construction. Inserts shall be of galvanized steel unless indicated or specified otherwise. Sleeves required for the passage of pipes through concrete or masonry construction shall be standard weight zinc-coated steel pipe or cast iron as specified in Section: "Piping and Valves".

7.3 Frames for door openings shall be constructed of structural steel as shown. Jambs shall be fitted accurately to the head and reinforced with clip angles on the concealed surfaces. Joints shall be welded along their entire length and exposed rivets or screw heads shall be countersunk flush with the adjacent surface. Exposed edges of frame components shall be smooth and frames shall be securely anchored to the supporting construction with 2-inch by 3/16-inch steel straps spaced not more than 3 feet on centers along the jambs. Frames shall be tapped for the attachment of collateral materials and equipment shall be reinforced to develop the full strength of the machine bolt or screw threads. Jambs shall be mortised to receive lock bolts or strikes and where stops are required, they shall be carbon steel flat bars welded to the frames.

7.4 Steel floor gratings shall conform to Type I or Type II of RR-G-661 and shall have zinc-coated finish. End banding bars shall be provided unless indicated otherwise.

7.5 Ladder(s) shall be constructed of structural steel as indicated. Exposed ends of rungs shall be finished smooth. Brackets of suitable sizes shall be provided at intervals not to exceed 10 feet and to secure a rigid installation with the centers of the rungs not less than 7 inches from the adjacent construction. Spreaders shall be provided and ladder assemblies shall be securely anchored to the supporting construction. All ladders shall conform to the requirements for Fixed Ladders, Article 1910.27 of the Occupational Safety and Health Act.

7.6 Railing(s) shall be of the type, materials and construction indicated or specified and shall be in one length for each run where practicable. Fixed railing shall be securely anchored to the supporting construction.

7.6.1 Pipe railings shall be of the configurations indicated with flush shop-welded, field-mechanical joints. Railings shall be complete with standards, brackets, caps, plugs and all other accessories and fastenings for a complete installation.

(a) Steel pipe railing(s) shall be fabricated from standard-weight zinc coated steel pipe having a nominal inside diameter of 1-1/2 inches.

7.7 Access Hatch and Frame for Fill Port Containment Basins:

7.7.1 Type I: Access hatch shall be 1/4 inch aluminum diamond pattern plate suitable to withstand a line load of 300 pounds per square foot. Channel frame shall be 1/4 inch aluminum with anchor flange around the perimeter. Door shall be equipped with heavy forged brass hinges, stainless steel pins, spring operator suitable for "one hand" operation, and an automatic hold open arm with release handle. A snap lock with removable handle shall be provided. A 1 1/2 inch drainage coupling shall be provided in the right front corner of the channel frame. Mill finish with bituminous coating shall be applied to exterior of the frame.

7.7.2 Type II: Access hatch and frame shall be aluminum construction similar to Type I as specified except that hatch and frame shall be designed to withstand H-20 wheel loadings.

7.8 Loose Lintels: Provide structural steel loose lintels over openings in masonry walls and partitions as indicated and to support wall loads over openings for heating and ventilating ducts and other openings. Lintels shall be complete with connections, fasteners and/or welds. Lintels shall be constructed to have a minimum of 8 inches bearing on masonry at each end, except as indicated otherwise.

7.9 Safety nosings shall be of cast iron not less than 5/16 inch thick with an abrasive aggregate cast integral with the wearing surface. Nosings shall be not less than 4 inches wide and shall extend the full length of each step tread, landing and floor edge or as indicated. Suitable anchors, spaced not more than 15 inches on centers, shall be provided to secure the nosings to the supporting construction.

7.10 Guard Protection Posts shall be constructed as detailed with 4 inch diameter galvanized steel pipe set in concrete. Center of post shall be filled with mortar, and galvanized cap shall be welded to top of pipe.

7.11 Airfield Trench Drain Covers for Site MCAS-A shall be cast iron or ductile iron of a properly designed section to safely support the aircraft wheel loads of a C-130. The C-130 has a single tandem landing gear with a wheel load of 42,000 pounds at a tire pressure of 90 pounds per square inch. The centerline distance between the two

wheels on one side is 60 inches and the width of 14 feet 3 inches. The covers shall have a minimum open area of 45 percent. The trench grating cover widths shall be of appropriate dimensions to limit the total weight to not more than 250 pounds. The trench covers shall be certified for each different size shown.

7.12 Elastomeric pad between concrete and steel structures shall be made of natural or synthetic rubber or polyvinyl chloride; shall be dense, homogenous, free from porosity and other imperfections. Material shall be resistant to chemical action with portland cement acids and alkalis.

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DIVISION 6. CARPENTRY

SECTION 06242. CARPENTRY AND WOODWORK

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

1.1 Federal and Military Specifications:

FF-B-561c	Bolts, Lag.
FF-B-575c	Bolts, Hexagon and Square.
FF-B-588c	Bolts, Toggle: and Expansion Sleeve, Screw.
& Am 1	
FF-N-105B	Nails, Wire, Brads, and Staples.
& Am 3	
FF-S-325	Shield, Expansion; Nail Expansion; and Nail,
& Int Am 3	Drive Screw (Devices, Anchoring; Masonry).
FF-S-111D	Screw, Wood.

1.2 U.S. Department of Commerce Standards:

PS 1-74	Construction and Industrial Plywood
PS 20-70	American Softwood Lumber Standard
PS 51-71	Hardwood and decorative plywood

1.3 American Wood Preservers' Bureau (AWPB):

LP-2, Jul 1971	Standard for Softwood Lumber, Timber, and Plywood Pressure Treated with Waterborne Preservatives for Above Ground Use.
LP-3, Jul 1971	Standard for Softwood Lumber, Timber and Plywood Pressure Treated with Light Petroleum Solvent-penta Solution for Above Ground Use.
LP-4, Jul 1971	Standard for Softwood Lumber, Timber, and Plywood Pressure Treated with Volatile Petroleum Solvent (LPG) Penta Solution for Above Ground Use.

1.4 National Forest Products Association (NFPA):

National Design Specification for Wood Construction with Supplement, 1977 Edition.

2. SUBMITTALS:

2.1 Tests and Certificates: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that the materials furnished for this project conform to all requirements of this specification and the referenced

documents. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

2.1.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and the respective reference specifications:

MANUFACTURER AND PRODUCT

REFERENCE SPECIFICATION

John Doe Company
Preservative Treated Lumber

AWPB LP-4

SIGNATURE AND TITLE

3. DELIVERY, STORAGE, AND PROTECTION: Materials shall be delivered to the site in an undamaged condition. Materials shall be carefully stored off the ground to provide proper ventilation, drainage, and protection against dampness. Defective and damaged materials shall be replaced by the Contractor at no expense to the Government.

4. MATERIALS: All lumber and plywood shall be grade-marked and trade-marked in accordance with PS 20 or PS 1 and the rules of the association governing for the species, or shall be accompanied by certificates of inspection as specified in section "General Paragraphs".

4.1 Lumber: Except as otherwise specified, lumber shall be of a species and grade that has an allowable single-member bending stress (Fb) of not less than 575 psi and a modulus of elasticity (E) of not less than 1,400,000 psi, as listed in NFPA National Design Specification.

4.2 Trim and Finish Lumber: Southern Pine or Douglas Fir, first grade of the species for natural finish and second grade of the species for pain finish.

4.3 Softwood Plywood: PS 1.

4.3.1 Plywood Used for Roof Deck: GC Exterior Type, grade Structural I.

- 4.4 Hardwood Plywood: PS 51.
- 4.5 Wire Nails and Staples: FF-N-105.
- 4.6 Wood Screws: FF-S-111.
- 4.7 Tacks: FF-N-105.
- 4.8 Bolts, Nuts and Studs: FF-B-575.
- 4.9 Lag Screws and Lag Bolts: FF-B-561.
- 4.10 Toggle Bolts: FF-B-488.
- 4.11 Shield, expansion: FF-S-325.

4.12 Preservative Treatment: The following items shall be preservative treated in accordance with the standards listed:

(a) All concealed wood materials in contact with exterior masonry, concrete, or metal: Pressure treatment, AWPB LP-2, LP-3, or LP-4.

(b) All wood blocking, nailers, cants, and edge strips used in built-up roofing systems: Pressure treatment, AWPB LP-2.

(c) All exposed wood materials subject to rain wetting or in contact with exterior masonry, concrete, or metal: Pressure treatment: AWPB LP-2 or LP-4.

(d) All exterior millwork such as door and window trim: Non-pressure treatment, CS 262.

Where water borne preservatives are used, lumber shall be redried to a moisture content of 19 percent or less. Holes and cuts made after treatment shall be brush coated with the same material as used in the treatment.

4.13 Screen over ventilation openings shall be galvanized steel or aluminum 18 x 16 wire mesh insert screen.

5. INSTALLATION:

5.1 Rough Carpentry: Fit closely, set accurately to the required lines and levels, and secure in place in a rigid and substantial manner. Spiking, nailing, and bolting shall be done in an approved manner; spikes, nails and bolts shall be of the proper size, and care shall be taken so as not to split the members. Members shall be drilled accurately for bolting; suitable washers shall be provided under heads; and nuts and bolts shall be drawn up tight.

5.2 Millwork and Finish: Joints shall be tight and constructed in a manner to conceal shrinkage. Trim and moldings shall be mitered at exterior angles and shall be coped at interior angles and at returns. Material shall show no warp. Millwork and trim shall be installed in the maximum practical lengths. Finish work shall be fastened with finish nails. Blind nailing shall be provided where practicable. Face nails shall be set for putty stopping.

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DIVISION 7. MOISTURE PROTECTION

SECTION 07221. MASONRY WALL INSULATION

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

1.1 Federal Specifications (Fed. Spec.):

HH-I-574B & Int Am 1	Insulation, Thermal (Perlite).
HH-I-585C & Int Am 1	Insulation, Thermal (Vermiculite).

1.2 American Society for Testing and Materials (ASTM) Publications:

C270-73	Mortar for Unit Masonry
D41-73	Primer for Use With Asphalt in Dampproofing and Waterproofing.
D312-71 (R 1977)	Asphalt for Use in Constructing Built-Up Roof Coverings.

2. QUALITY CONTROL:

2.1 Certificates of Conformance or Compliance: Submit certificates attesting that the materials meet the requirements specified.

2.2 Samples: Submit samples of the following:

a. Loose Fill Insulation: Two pint size containers.

2.3 Manufacturer's Data: Submit current copies of the manufacturer's data with samples, including descriptive literature, insulating characteristics, and instructions for installation and protection of insulation.

3. DELIVERY AND STORAGE: Materials shall be delivered to the site in the original sealed containers or packages, and shall bear the manufacturer's name and brand designation. The containers or packages shall bear the referenced specification number, type, and class as applicable. Inspect materials delivered to the site for damage and unload and store with a minimum of handling. Storage spaces shall be dry locations, but subject to open flame or sparks, and permitting easy access for inspection and handling.

4. MATERIALS: Provide materials conforming to the respective specifications and requirements specified herein.

4.1 Insulation: Provide loose fill type insulation conforming to one of the following referenced specifications:

- (a) Perlite Loose Fill: Fed. Spec. HH-I-574.
- (b) Vermiculite Loose Fill: Fed. Spec. HH-I-585, Type

II, Class 2.

5. **CONDITION OF SURFACES:** Wall surfaces of cavities against which insulation is to be applied shall be clean and dry. Check surfaces for protruding mortar, concrete, or other obstacles that may interfere with the installation of the insulation. Remove such obstacles, if present, before insulation is applied.

6. **INSTALLATION:** Install insulation in accordance with the manufacturer's approved instructions and the requirements specified herein. Insulate exterior single-wythe hollow-masonry-unit walls by completely filling the cells of the units with loose-fill insulation. Extend insulation over entire surface to be insulated. Extend insulation over entire surface to be insulated.

6.1 **Loose-fill Insulation:** Bring up insulation alternately with the masonry, with more than a 2-foot-high section of wall completed before insulation is poured into the cells of the masonry units. Completely fill cells with insulation. Pour the insulation from the top of each height of wall section completed, allowing it to assume its natural density. Do not tamp insulation. Maintain inspection ports to show presence of insulation at the extremities of each pour area. Close ports as directed after complete coverage has been confirmed.

7. **FIELD INSPECTION:** Following installation of loose-fill insulation, insure that all exterior walls are filled to the top, all electrical outlet boxes and fixtures are sealed, and insulation has not leaked through unsealed openings.

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SECTION 07241. ROOF INSULATION

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

1.1 Federal Specifications:

NH-I-526C	Insulation Board, Thermal-acoustical Mineral Wool (for Roofs).
NH-I-529B	Insulation Board, Thermal, (Mineral Aggregate).
NH-I-551E	Insulation Block and Boards, Thermal (Cellular Glass).
SS-C-153C	Cement; Bitumastic, Plastic.

1.2 American Society for Testing and Materials (ASTM):

D41-73	Primer for Use with Asphalt in Dampproofing and Waterproofing.
D226-75	Asphalt-saturated Roofing Felt for Use in Waterproofing and in Constructing Built-up Roofs.
D312-71	Asphalt for Use in Constructing Built-up Roof Coverings.
D2626-73	Asphalt Base Sheet for Use in Construction of Built-up Roof.
D84-76A	Surface Burning Characteristics of Building Materials.

2. QUALITY CONTROL: The Quality Control provisions of Division 1, General Requirements, apply to this section. Approvals, except those required for field installations and field tests, shall be obtained before delivery of materials to the project site.

3. SUBMITALS:

3.1 Catalog Data: Submit complete literature for each type of each of the following items. Data which describe more than one material, type, size or item shall be clearly marked to indicate which material, type, size or item the Contractor intends to provide. Data shall be sufficient to show conformance to specified requirements and shall include installation instructions.

Roof Insulation
Primer
Felts
Asphalt
Adhesive

3.2 Tests and Certificates: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture and make as those tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

4. DELIVERY AND STORAGE: Materials shall be delivered to the site in the original sealed containers or packages, and shall bear the manufacturer's name and brand designation. Where materials are covered by a referenced specification, the containers or packages shall bear the specification number, type, and class as applicable. Materials shall be stored, handled and installed in a manner to protect them from all damage and from wetting and moisture absorption during the entire construction period. Insulation not stored in buildings or trucks shall be stored above ground on wood pallets and covered with suitable waterproof covering. For 24 hours immediately before laying, felt rolls shall be stacked on ends and stored in an area maintained at a temperature not lower than 50 degrees F. All damaged material shall be replaced by the Contractor at no expense to the Government.

5. ENVIRONMENTAL CONDITIONS: The application of roof insulation will not be permitted on any roof deck when the surface temperature is below 40 degrees F or when there is ice, frost, or dampness visible on the roof deck.

6. PROTECTION OF PROPERTY: Protection shall be provided as specified in SECTION: BUILT-UP BITUMINOUS ROOFING.

7. MATERIALS: Materials shall conform to the respective specifications and standards and to the requirements specified herein.

7.1 Roof Insulation:

7.1.1 Roof Insulation shall be one of the following materials:

(a) Mineral fiber board: HH-I-526, except that the top surface of the insulation shall have an impact-resistant, factory-applied facing.

(b) Expanded perlite board: HH-I-529.

(c) Cellular glass boards: HH-I-551, type IV. Cellular glass boards shall not be used over steel decking having rib openings greater than 2-3/8 inches wide.

7.1.2 Insulation Thickness: Insulation thickness shall be as necessary to provide a "C" value of 0.12 or less. Any additional materials required due to insulation being provided with thickness other than that indicated shall be provided at no additional cost to the Government.

7.1.3 Surface Burning Characteristics: Roof insulation shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50, exclusive of covering, when tested in accordance with ASTM E84. Insulation bearing the UL label and listed by Underwriters' Laboratories as meeting the flame spread and smoke developed ratings specified herein will be accepted in lieu of certified copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when the insulation has been tested as a part of a roof construction assembly of the type as used for this project and the construction is listed as being fire-acceptable by Underwriters' Laboratories, Inc., or listed as Class 1 construction by Factory Mutual Engineering Corporation. Insulation tested as a part of a roof construction assembly shall be provided with Underwriters' Laboratories, Inc. or Factory Mutual Engineering Corporation labels attesting to the ratings specified herein.

7.2 Cants and Tapered Edge Strips: Preformed cants and tapered edge strips shall be of the same material as used for roof insulation. If the roof insulation manufacturer cannot furnish cants and edge strips rigid perlite board conforming to HH-I-529 or treated wood cants and edge strips shall be provided.

7.3 Steep Asphalt: ASTM D12, Type III or IV.

7.4 Plastic Cement: SS-C-153.

8. CONDITION OF SURFACES:

8.1 General: All surfaces on which insulation are to be applied shall be clean, smooth and dry. The condition of the surfaces shall be inspected and approved by the Contracting Officer immediately before the work is started.

8.2 Roof Deck Surfaces: The application of roof insulation will not be permitted on roof decks when the temperature is below 40 degrees F. or when there is ice, frost, or dampness visible on the roof deck. All roof deck surfaces shall be checked for defects before any work is started; any defects or inaccuracies in the roof deck surface shall be corrected in a satisfactory manner so as to eliminate poor drainage, hollow, and low spots.

9. APPLICATION:

9.1 General: Roof insulating materials shall be applied to the roof surfaces indicated in accordance with the requirements specified herein. All roof insulating materials used shall be kept dry before, during and after installation.

9.2 Temperature of Steep Asphalt: In the application of insulation, steep asphalt shall not be heated above 450 degrees F and shall not be less than 350 degrees F at the time of application. Thermometers shall be used to check the temperatures during the heating and application. Kettlemen shall be in attendance at all times during the heating process to insure that the maximum temperature specified is not exceeded.

9.3 Wood Nailers: Treated wood nailers are specified in another section. Nailers shall equal the thickness of the insulation and shall be provided at all eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, gutters, and flashing flanges.

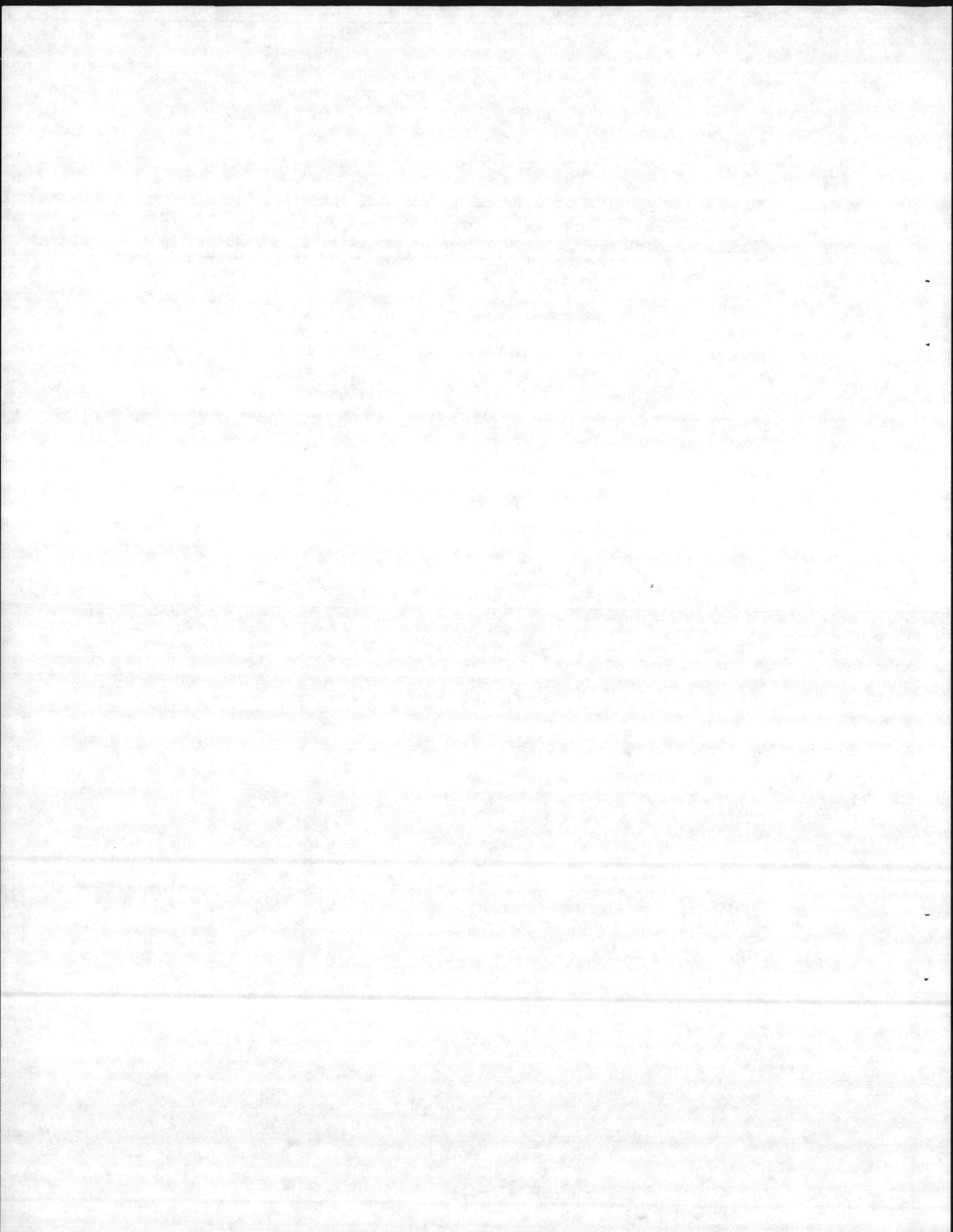
9.4 Insulation: Insulation shall be laid so that the longitudinal (continuous) joints are parallel to the short dimension of the roof and so that end joints of each course break with those of the adjoining courses. When using multiple layers of insulation, the joints of each succeeding layer shall be parallel and broken in both directions with respect to the layer below. Each layer shall be firmly embedded in a solid steep asphalt mopping; only sufficient area to provide complete embedment of one board shall be mopped at a time. Not less than 25 pounds of asphalt per 100 square feet of roof deck shall be used for mopping each layer of insulation in place, except as specified otherwise. The insulation shall be placed while the asphalt is still hot and fluid. When multiple layers of insulation are used, the second layer and all succeeding layers shall be mopped in as specified herein.

9.5 Cant Strips: Where indicated, cant strips shall be provided at intersections of the roof with walls, parapets, and curbs extending above the roof. The face of the cant strips shall have an incline of 45 degrees. Where possible, cant strips shall be nailed to adjoining surfaces. Where installed against non-nailable materials, the cant strips shall be applied in a heavy mopping of steep asphalt or set in plastic cement.

10. PROTECTION OF APPLIED INSULATION: Each day's application of insulation shall be completely covered with finished roofing if practical. Each day's application of insulation or insulation-underlayment which cannot be roofed over shall be covered with at least a glaze coat of hot bitumen. Glazed coats, applied to surfaces which are to receive built-up roofing, shall be of the same type of bitumen as that used in the application of the roofing. The open ends of each day's work shall be protected with temporary water cut-offs which shall be removed when the work is resumed. Open spaces between insulation and parapets (or other walls), and spaces at curbs, scuttles, expansion joint, etc., shall be protected until permanent roofing and flashing is applied. Storing,

walking, wheeling, or trucking will not be permitted directly on insulation, or on roofed surfaces; smooth, clean board or plank walkways, runways, and platforms shall be provided near supports, as necessary, to distribute weight to conform to indicated live load limits of the roof construction.

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SECTION 07510. BUILT-UP BITUMINOUS ROOFING

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

1.1 Federal Specifications:

SS-C-153C	Cement; Bituminous, Plastic.
SS-R-620B	Roofing Felt; Glass Fiber, Asphalt Coated (for Flashing and Roofing).

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

D41-73A	Primer for use with asphalt in dampproofing and waterproofing.
D173-74	Woven cotten fabrics saturated with bituminous substances for use in waterproofing.
D226-75	Asphalt-saturated roofing felt for use in waterproofing and in constructing built-up roofs.
D250-70	Asphalt-saturated asbestos felts for use in waterproofing and in construction built-up roofs.
D312-71	Asphalt for use in constructing built-up roof coverings.
D1227-65(1970)	Asphalt Base Emulsions for use as protective coatings for built-up roofs.
D1863-64(1970)	Mineral aggregate for use on built-up roofs.
D1866-71	Translucency of mineral aggregate for use on built-up roofs.
D2626-73	Asphalt base sheet for use in construction of built-up roofs.

1.3 Corps fo Engineers:

EM 385-1-1	General Safety Requirements Manual.
1 June 1973	

2. ROOFING SYSTEM: Roofing system shall be one of the following:

2.1 Type AAA. Asbestos felt, asphalt saturated, aggregate surfaced.

Materials per 100 sq. ft. of Roof (lbs. min., except that where two figures are indicated, they are the minimum and maximum)

Components	Substrate	Insulation
Felt		
RB40		1 Ply - 37
RA15		3 Plies - 39
Asphalt		
On substrate		Type III 25
Between plies		45-60
Top Pouring		60
Surfacing		
Gravel		400
or Slag		300
or Optional mat'l		300
Cut Test weight (ounces)		21.0-23.2

2.2 Type GAA. Glass fiber, asphalt coated, aggregate surfaced.

Materials per 100 sq. ft. of Roof (lbs. min., except that where two figures are indicated, they are the minimum and maximum.)

Components	Substrate	Insulation
Felt		
GB14		1 Ply - 12.8
GB14 Comb. Sheet		-----
GA8		3 Plies - 22.5
Asphalt		
On substrate		Type III 30
Between plies		60-90
Top Pouring		60
Surfacing		
Gravel		400
or Slag		300
or Optional mat'l		300
Cut Test weight (ounces)		17.2-21.5

3. QUALITY CONTROL: Approvals, except those required for field installations, field applications and field tests, shall be obtained before delivery of materials to the project site.

3.1 Materials Tests and Test Reports: The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

3.2 Certificates of Conformance or Compliance: Before delivery of materials, submit in triplicate, certificates from the manufacturer certifying that materials provided are chemically and physically compatible with each other and are suitable for inclusion within the total roof system specified herein. The acceptance of certification shall in no case jeopardize the Government's right to test materials when tests are deemed necessary to ensure compliance.

3.3 Descriptive Data: Before delivery of any materials to the building site, descriptive data on all roofing materials shall be submitted and approved.

4. DELIVERY, STORAGE AND HANDLING: Manufactured roofing materials shall be delivered in manufacturers' original unopened containers and rolls with labels intact and legible. Where materials are covered by a referenced specification number, the containers shall bear the specification number, type, and class, as applicable. Materials shall be delivered in sufficient quantity to allow continuity of work. Roll materials shall be handled so as to prevent damage to edge or ends, shall be protected against wetting and moisture absorption, and shall be stored on end on clean raised platforms in dry locations with adequate ventilation. Roll materials shall not be stored in any building under construction until concrete, masonry work, ceramic tile, terrazzo, and plaster are dry. Wet materials shall be marked and removed from the project site. Immediately before application, roll materials shall be stored for 24 hours in an area maintained at no lower temperature than 50°F. Not more than one day's supply of felts shall be stored on the roof at any time, stacked on pallets and completely covered with weatherproof protective coverings whenever work is interrupted or when there is precipitation of any kind. Covering shall be securely tied to the pallets in such a way as to be completely weather-tight and yet provide sufficient ventilation to prevent condensation. Materials temporarily stored on the roof shall be located in approved areas and shall be distributed to stay within the indicated live load limits of the roof construction. Emulsions shall be stored in temperatures above 40 degrees F. Material handling equipment shall be selected and operated so as not to damage existing construction or applied roofing. Storage, walking, wheeling or trucking will not be

permitted directly on roofing surfaces. Smooth, clean board or plank runways and platforms shall be provided near supports as necessary to distribute weight to conform to indicated live load limits of the roof construction. Equipment for roofing work shall be rubber tired.

5. MATERIALS:

5.1 Asphalt:

Roof Slope (in./ft.)	Specification	Softening Point (°F)
Up to and including 1/2	ASTM D312, Type I	135-150

5.2 Asphalt Primer: ASTM D41.

5.3 Asphalt-Base Emulsion: ASTM D1227, Type I.

5.4 Bituminous Plastic Cement: SS-C-153. Type I shall be used for asphalt saturated or coated materials and Type II for coal-tar saturated materials.

5.5 Aggregates for Surfacing Built-up Roofing: ASTM D1863. Aggregates shall be commercial grade, washed gravel, crushed stone, crushed blast furnace, slag or other approved light colored materials opaque to ultraviolet radiation when tested in accordance with ASTM D1866.

5.6 Unsaturated Felt or Rosin-sized Building Paper: Minimum weight shall be 5 pounds per 100 square feet.

5.7 Woven Cotton Fabric: ASTM D173, Type C Asphalt Saturated, or Type A Coal-tar saturated.

5.8 Nails and Fasteners: Nails shall be galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel. Fasteners shall be self-clinching type or penetrating type as recommended by the manufacturer of the deck material. Nails and fasteners shall be flush driven through flat metal discs of not less than 1-3/8 inch diameter. Metal discs may be omitted when one piece composite nails or fasteners with heads not less than one inch diameter are used. Unless otherwise specified, minimum withdrawal resistance of nails or fasteners shall be 40 pounds each in the specific decks, when driven.

5.8.1 Wood Nailers and Wood Decks: Roofing nails for wood nailers and wood decks, except plywood, shall be 11 gage, barbed, zinc-coated nails with 7/16 to 5/8-inch diameter heads. Annular ring shank, square head, one-piece, composite nails shall be used with plywood decks and

may be used on other wood decks. Nails shall be long enough to penetrate into the wood nailers or wood decks at least 5/8-inch and into plywood decks 1/2-inch but shall not protrude through the underside of the decking. Zinc coated staples of an approved type, applied through metal caps, may be substituted for composite nails on plywood decks.

5.8.2 Block or Board-Type Insulation: Felts shall be nailed to wood nailers (insulation stops) with 11 gage, barbed zinc-coated nails with 7/16 to 5/8-inch diameter heads. Nails shall be long enough to penetrate into wood nailers at least 5/8-inch.

5.8.3 Masonry or Concrete: Special hardened nails shall be used when nailers are not provided.

5.9 Metal Discs: Flat discs or caps of zinc coated sheet metal not lighter than 28 gage and not less than 1-3/8 inches in diameter. Disc shall be formed to prevent dishing. Bell or cup-shaped caps are not acceptable.

5.10 Felts for Built-up Roofing and Flashing:

<u>Designation</u> (Symbol and Nominal Weight)	<u>Use</u>	<u>Felt</u>	<u>Saturant</u>	<u>Coating</u>	<u>Specification</u>
AA15	Plying Felt	Asbestos (Perforated)	Asphalt	None	ASTM D250 Min. wt. 13 lb/sq.
GA8	Plying Felt	Glass Fiber	None	Asphalt	SS-R-620, Type I Modified Min. wt. 7.5 lb/sq.
RB40	Base Sheet	Rag	Asphalt	Asphalt	ASTM D 2626, Type I or II, Min. wt. 37 lbs/sq.
GB14	Base Sheet	Glass	None	Asphalt	SS-R-620, type II Min. Wt. 12.8 lbs/sq.
GB14 Combination	Base Sheet	Glass	None	Asphalt	SS-R-620, Type IV Min. wt. 12.3 lbs/ sq. with kraft paper laminated to bottom.

6. PREPARATION: The work shall be coordinated with that of the other trades to assure that components which are to be secured to or stripped into the roofing system are available and that flashing and counter flashing is installed as the work progresses. Protective devices for safeguarding workers exposed to slipping and falling hazards

inherent in roofing operations, shall be provided by the Contractor. The specific safety requirements are located in Sections 1926.500(d)(1) and 1926.451(u) of the Occupational Safety and Health Act of 1970 and Section 22.C of the Corps of Engineers General Safety Manual, EM385-1-1.

6.1 Condition of Surfaces: All surfaces to which built-up roofing is to be applied shall be examined to assure that their condition is satisfactory for application of the roofing system. Particular attention shall be paid to the requirements listed herein. All defects that will adversely affect proper application of the roofing system shall be corrected and the surfaces shall be inspected and approved immediately before the application of the roofing materials.

6.1.1 All drains, curbs, cants, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports shall be in place.

6.1.2 Surfaces shall be rigid, dry, smooth, and free from cracks, holes, and sharp changes in elevation. The level of the deck shall not vary more than 1/4-inch within an area 10 feet by 10 feet.

6.1.3 Decks shall have been designed and built with adequate slope to provide free drainage to the drains without ponding water between supporting members, and shall be adequate to support and securely hold the roofing system by the specified method of attachment.

6.1.4 Walls and all vertical surfaces, to which roofing is to be flashed shall have been so constructed as to be waterproof above the flashing line, and in all cases, shall permit nailing of the base flashing.

6.1.5 Treated wood nailers shall be in place at all eaves, gable ends, and openings and intersections with vertical surfaces on non-nailable decks for securing of roofing felts, edging strips, gravel stops, and roof fixtures. Embedded nailers shall be flush with deck surfaces. Where roof insulation is provided, nailers shall be the same thickness as the insulation.

6.1.6 Cants shall be securely fastened in place in the angles formed by walls and other vertical surfaces as backing for the base flashing. The angle of the cant shall be 45° and the height of the vertical leg at least 4 inches. Non-nailable insulation board, lightweight insulating concrete fill, or asphaltic fill cants are not acceptable.

6.1.7 Venting Requirements: Where venting of insulation is specified, the following shall be checked and coordinated with other trades to assure the following has been provided:

(a) Edge Venting: Perimeter nailers shall be grooved to permit escape of vapor at roof edges.

6.1.8 Concrete: Roofing materials shall not be applied until after the material has been properly cured and seasoned, all shrinkage has occurred, and the surface dryness requirements specified herein, have been met.

6.1.9 Wood Decks shall be checked to assure the following: Decks shall be dry, treated wood securely fastened to the purlins with all exposed nail heads properly set. Warped and split boards shall have been replaced. Cracks over 1/4-inch in width, end joints 1/2-inch or more in width, and all knot holes shall have been covered with sheet metal nailed in place. Joints in plywood decks shall have been taped with 2-inch-wide masking tape to prevent air leakage from the underside.

6.1.10 Insulation or Underlayment: Surface shall be smooth and even without broken or cracked boards. Where wood nailers are used they shall be the same thickness as the insulation and shall be securely fastened to the roof deck.

6.2 Priming of Surfaces:

6.2.1 After surface dryness requirements specified herein have been met, concrete and masonry surfaces which are to receive roofing and flashing shall be coated uniformly with asphalt primer at the rate of one gallon per 100 square feet. The primer shall be allowed to dry thoroughly prior to application of the roofing and flashing materials.

6.2.2 Flanges of metal gravel stops, edging strips, flashing colars, and accessories shall be primed and allowed to dry thoroughly prior to stripping into the roofing system.

6.3 Wood decks shall be covered with a layer of unsaturated felt or rosin-sized building paper lapped 2 inches on sides and ends and railed sufficiently to hold it in place immediately prior to application of the roofing system. Where a combination sheet, consisting of a base sheet with kraft paper laminated on the bottom, is included in the roofing system, the unsaturated felt or rosin-sized building paper may be omitted.

7. APPLICATION: The application of the complete roofing system, including top surfacing, shall be finished in one operation. Top surfacing shall be brought up to within 3 to 5 feet of the line of termination of each days work, and all exposed felts, including base sheets, shall be protected with a glaze coat of hot bitumen applied at a rate of not less than 25 pounds per 100 square feet. In all procedures in which hot bitumen is used in the bonding of materials to each other, or in laminating plies of felt into composite membrane,

the operation shall be such that the application of the material which is laid into the bitumen shall follow immediately behind the application of the hot bitumen. There shall be no working ahead with the bitumen. The bitumen must be completely fluid, with mop temperature within the range specified at the instant the superimposed material comes into contact with the bitumen. Felts and surfacing aggregates shall be embedded in, not laid on, the bitumen. Application of bitumen between membrane plies shall be such as to produce voidless coverage and complete penetration of the bitumen, both into the felt above and into the felt below. As sheet materials are being rolled into the hot bitumen, they shall be immediately and thoroughly broomed down to eliminate any air which might have been trapped and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. Complete application of the roofing system shall be without pockets and blisters. The practice of laying the felts dry and turning back the laps for mopping between plies will not be permitted. Roofing felts shall be applied at right angles to the roof slope so that the direction of flow or water is over, and not against the laps, except that on insulated roofs, where surface-applied wood nailers (insulation stops) have been applied running at right angles to the roof slope, the roofing felts shall be applied parallel to the roof slope so that prevailing winds are over, and not against the laps. All roofing plies shall be extended to the top of the cant strips. Felts shall be trimmed to a neat fit around vent pipes, roof drains and other projections through the roof.

7.1 Environmental Conditions: Application will not be permitted during inclement weather or when air temperatures are below 40 degrees F or are expected to go below 40 degrees F within 24 hours after application, or when there is ice, frost, surface moisture or visible dampness on the roof deck.

7.2 Protection of Property:

7.2.1 Flame heated equipment shall be located and used so as not to endanger the structure or other materials on the site or adjacent property. Flame heated equipment shall not be placed on the roof of any structure. Ample fire extinguishers shall be provided and maintained.

7.2.2 Protective coverings shall be installed at all paving and building walls adjacent to hoise and kettles prior to starting the work. Protective coverings shall be lapped at least 6 inches, shall be secured against wind, and shall be vented to prevent collection of moisture on covered surfaces. Protective coverings shall remain in place for the duration of the roofing work.

7.2.3 Special protection shall be provided, or heavy traffic shall be avoided on completed work when ambient temperature is above 80 degrees F.

7.2.4 Work or materials damaged during the handling of bitumen and the installation of materials shall be restored to original condition or shall be replaced with new materials.

7.2.5 Joints in deck shall be sealed as necessary, to prevent drippage of bitumen into building or down exterior walls.

7.3 Heating of Bitumen: Solid bitumen shall be broken up on a clean surface, free of dirt and debris, and shall be carefully heated in kettles so designed as to prevent direct contact of flame with surfaces in contact with the bitumen. Kettles shall be provided with visible thermometers and thermostatic controls set to the temperature limits specified. Controls shall be maintained in working order and shall be kept calibrated. Accurate "plus or minus two degrees" immersion thermometers shall be used frequently to check temperatures of the bitumen. When temperatures exceed maximums specified, the bitumen shall be rejected and removed from the site. Upon determination that the temperature of the bitumen, at the instant of application is below minimums specified, the affected roofing shall be removed and replaced. Cutting back, adulterating, or fluxing of bitumen, or prolonged storage at temperatures above storage temperatures specified will not be permitted.

7.3.1 Temperature Limits for Bitumens: Bitumens shall be heated within the following ranges:

<u>Bitumen</u>	<u>Minimum Temp., °F</u>	<u>Best Range, °F</u>	<u>Maximum Temp., °F</u>	<u>Storage Temp., °F</u>
Asphalt, ASTM D312, Type I	300	350-400	425	350
Asphalt, ASTM D312 Types II, III	350	400-430	475	425

7.4 Bitumen Stops shall be provided at roof edges, openings, and vertical projections prior to application of the roofing felts. Bitumen stops shall be formed with two 12-inch wide strips of ply felt. Strips shall be laminated with, and set into a bed of bituminous plastic cement with one half of the width overhanging the edge of the roof or opening. Where nailers are present, the strips, additionally shall be nailed with roofing nails spaced 12 inches o.d. After roof membrane is in place, the free portion of the strips shall be folded back over the roof membrane and embedded in a continuous bed of bituminous plastic cement. The gravel stop, where indicated, shall be embedded in the bituminous plastic cement on top of the envelope formed by the turn-back and shall be secured with compatible roofing nails spaced 3 inches o.c. Metal bitumen stops as specified in section entitled "Flashing and Sheet Metal" may be provided in lieu of the felt bitumen stops at the Contractor's option.

7.5 Base Sheets shall be applied with each sheet lapping 4 inches over the preceding sheet. End laps shall not be less than 6 inches and shall be staggered a minimum of 12 inches.

7.6 Plying Felts: The application of plying felts shall be progressive and continuous (shingle fashion) and not split (or phased). Starter sheets of plying felts shall be provided to maintain the specified number of plies throughout the roof. Laps and starter sheet widths for 36-inch felts shall be as follows:

<u>Number of plies</u>	<u>Laps (inches)</u> ¹	<u>Starter sheet widths (inches)</u>
4	27-1/2	9, 18, 27 and 36

End laps shall not be less than 6 inches and shall be staggered a minimum of 12 inches.

7.7 Flashing: Built-up bituminous flashing shall be provided in the angles formed where roof decks abut curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Flashing shall be installed after all plies of roofing have been applied but before the top surfacing is applied. Base flashing shall be built-up of inorganic felts; Cap flashing shall be metal as specified in another section.

7.7.1 Built-up bituminous base flashing shall consist of 3 plies of AA15 felts. Each ply shall be embedded in a uniform trowelling of bituminous plastic cement not less than 1/16-inch thick. All felts shall be smoothed and pressed firmly into place so that a uniformly attached and completely laminated membrane results. Felts shall extend not less than 6, 9, and 12 inches respectively over the roofing membranes beyond the toe of the cant and not less than 4 inches or more than 10 inches above the top of the cant on vertical surfaces. Ends of felts shall be lapped not less than 12 inches and shall be sealed watertight with bituminous plastic cement. End laps shall be staggered. Top edges of base flashing system shall be nailed to nailers with large head roofing nails through metal discs spaced not more than 10 inches o.c. on a line 1-1/2 inches below the top of the felts. The finished base flashing shall be heavily coated with bituminous plastic cement 1/8-inch thick, extending from one inch above the top of the flashing felts on the vertical surface to one inch beyond the edge of the flashing felts on the roof surface.

7.7.2 Strip Flashing: Flanges of sheet metal work to be incorporated into the roofing system shall be set into a uniform 1/16-inch minimum thick bed of bituminous plastic cement and shall be stripped-in with two layers of plying felt cemented to the top of the flanges and to each other with 1/16-inch beds of bituminous plastic cement. The felts shall

extend 3 and 6 inches, respectively, beyond the edges of the flanges and shall cover the flanges.

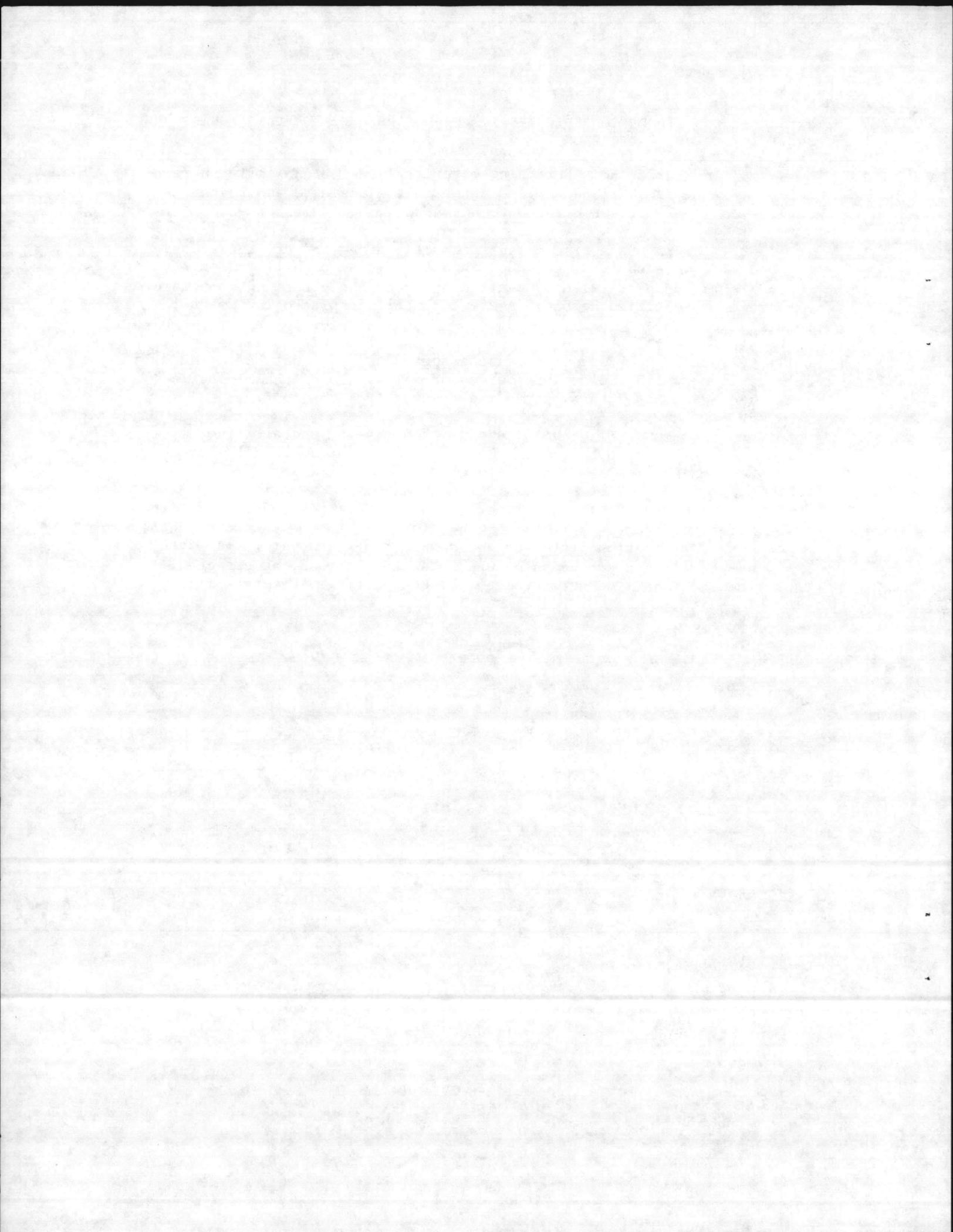
7.8 Top Surfacing: Surfacing materials, in the quantities hereinbefore specified, shall be applied after felt glashings, and tests, repairs, and corrective action have been completed and approved.

7.8.1 Aggregate surfacing shall consist of clean, dry aggregate, as specified hereinbefore, embedded in a flood coat of hot bitumen poured from a dipper. Bitumen shall conform to the slope and temperature requirements specified herein. Aggregate shall be placed in a manner required to form a compact, embedded overlay. To aid, in proper embedment, aggregate may be lightly rolled, provided that there is no damage to the built-up roofing membranes. Surfacing aggregate shall not be embedded in areas over which protection courses or walkways are to be installed. Loose aggregate shall be swept up and removed from the roof.

7.9 Clean-up: All debris, scraps, containers, and all other rubbish and trash resulting from the installation of the roofing system, shall be removed from the job site each day.

8. INFORMATION CARD: A typewritten card, framed under glass, in a weather-tight frame, shall be provided for each roof. This card shall contain the information listed on the sample roof data card. The card shall be installed near the point of access to the roof, as directed. A duplicate card shall be submitted to the Contracting Officer.

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SECTION 07600. FLASHING AND SHEET METAL

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

1.1 Federal Specifications:

O-F-506C	Flux, Soldering; Paste and Liquid.
QQ-C-576B & Am 1	Copper Flat Products with Slit, Slit and Edgerolled. Sheared, Sawed, or Machined Edges, (Plate, Bar, Sheet and Strip).
QQ-L-201F & Am 2	Lead Sheet.
QQ-S-571E & Am 2	Solder; Tin Alloy; Lead-Tin Alloy; and Lead Alloy.
QQ-S-775E	Steel Sheets, Carbon, Zinc-coated.
QQ-Z-301C	Zinc Sheet and Strip.
SS-C-153C	Cement; Bituminous, Plastic.

1.2 American Society for Testing and Materials (ASTM):

A167-77	Stainless and Heat Resisting, Chromium-Nickel Steel Plate, Sheet and Strip.
D41-73	Primer for Use with Asphalt in Dampproofing and Waterproofing.

1.3 Sheet Metal and Air Conditioning Contractors National Association, Incorporated (SMACNA) Publications:

Architectural Sheet Metal Manual (Second Edition 1968)

2. SUBMITTALS:

2.1 Shop Drawings: Submit shop drawings for approval indicating thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary to provide for thermal expansion and contraction. Scaled catalog cuts may be submitted for factory fabricated items. Submit shop drawings for the following items.

Gutters and downspouts.

Gravel stops and fascias.

Flashing at roof penetrations.

2.2 Certificates of Conformance or Compliance: Submit for approval certificates from the manufacturer attesting that materials meet the requirements specified herein.

3. DELIVERY, HANDLING AND STORAGE: Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the job site. Damaged or permanently stained materials that cannot be restored to like-new condition shall be removed from the site and shall be replaced at no additional cost to the Government. Carefully handle sheet metal items to avoid damage to surfaces, edges, and ends. Crated materials shall not be uncrated until ready for use. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

4. MATERIALS: Materials shall conform to the respective specifications and to the requirements specified herein. Furnish sheet metal items in 8-to 10-foot lengths. Single pieces less than 8 feet long may be used to connect to factory fabricated inside and outside corners, and at ends of runs. Accessories and other items essential to complete the sheet metal installation shall be provided and shall be of the same materials as the items to which they are applied.

4.1 Copper, Sheet and Strip: QQ-C-576, light cold rolled temper.

4.2 Lead Sheet: QQ-L-201, Grade B, minimum weight 4 lbs. per square foot unless otherwise indicated.

4.3 Steel Sheet, Zinc Coated (Galvanized): Fed. Spec. QQ-S-775, Type 1, Class D.

4.4 Zinc Sheet and Strip: Specification QQ-Z-301, Type 1, not less than 0.024-inch thick.

4.5 Stainless Steel: ASTM A167, Type 302 or 304, finish 2D, fully annealed, dead soft temper.

4.6 Soldering Flux: Fed. Spec. O-F-506, Type 1, Form A or B.

4.7 Solder: Fed. Spec. QQ-S-571, composition Sn 50 for copper and composition Sn 60 for stainless steel.

4.8 Bituminous Plastic Cement: Fed. Spec. SS-C-153, Type I with asphalt roofing felts.

4.9 Asphalt Primer: ASTM D41.

4.10 Fasteners: Fasteners shall be the same metal or a metal compatible with the item fastened. Use bronze, brass, or hard copper materials; and stainless steel fasteners with stainless steel and to fasten dissimilar materials.

5. OPTIONAL MATERIALS: Optional materials are listed in Table I. Any of the optional materials specified therein may be selected by the Contractor; however, all exposed sheet metal items shall be of the same

material. The following items shall be considered as exposed sheet metal: gutters, including hangers; downspouts and leaders; gravel stops and fascias; cap, valley, stepped, base, and eave flashings.

6. SHEET METAL: Provide flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes or other vertical surfaces and wherever indicated and necessary to make the work watertight. All sheet metal shall have mill finish unless specified otherwise herein. Tempers of metals shall be suitable for their respective forming conditions. Fabricate sheet metal items to the gage, thickness or weight shown in Table I and join multiple lengths of items together as shown in Table II.

7. INSTALLATION:

7.1 General: Surfaces to receive sheet metal shall be plumb and true, clean, even, smooth, dry and free from defects and projections which might affect the application. Installation of items not shown in detail or not covered by specifications shall meet the applicable requirements of the SMACNA Architectural Sheet Metal Manual.

7.2 Workmanship: Install sheet metal work with lines, arrises, and angles sharp and true. Exposed surfaces shall be free from visible wave, warp, and buckle, and tool marks. Exposed edges shall be folded back neatly to form a 1/2-inch hem on the concealed side. Sheet metal exposed to the weather shall be watertight with provisions for expansion and contraction.

7.3 Nailing of sheet metal shall be confined generally to sheet metal having a width of less than 18 inches. Nails shall be evenly spaced not over 3 inches on centers and approximately 1/2-inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, detailed shop drawings shall include locations for sleepers and nailing strips required to properly secure the work. Sleepers and nailing strips are specified in another section.

7.4 Bolts, Rivets, and Screws: Install bolts, rivets, and screws where indicated shall or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

7.5 Soldering, Welding and Mechanical Fastening: Where soldering is specified herein it shall apply to copper, zinc coated steel, and stainless steel items.

7.5.1 Soldering: Edges of sheet metals, except lead coated material, before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges

of lead coated material to be soldered shall be scraped or wire-brushed to produce a bright surface, and seams shall have a liberal amount of flux brushed in before soldering is begun. Edges of stainless steel to be pretined shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water.

7.6 Protection From Contact of Dissimilar Materials:

7.6.1 Copper or Copper-bearing Alloys: Surfaces in contact with dissimilar metal shall be painted with heavy-bodied bituminous paint, or shall be separated by means of moisture proof building felts.

7.6.2 Aluminum: Surfaces shall not contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, the dissimilar metal shall be painted with a primer followed by two coats of aluminum paint.

7.6.3 All Metal: Surfaces in contact with mortar, concrete, or other masonry materials shall be painted with alkali-resistant coatings such as heavy-bodied bituminous paint.

7.6.4 Wood or other absorptive materials: Surfaces that may become repeatedly wet and in contact with metal shall be painted with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

7.6.5 Dissimilar Metal: Paint with a non-lead-pigmented paint if drainage from it passes over aluminum.

7.6.6 Exposed Copper: Shall be lead coated if drainage from it passes over exposed masonry, stonework, or other metal surfaces.

7.7 Gravel Stops and Roof Edge Fascias: Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roof deck. Provide prefabricated mitered corners for internal and exposed corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascias on both sides with an asphalt primer. After primer has dried, set flange on top of the roofing felts in a 1/8-inch thick bed of plastic cement. Nail flange securely to wood nailer with large-head barbed-shank roofing nails 1-1/2 inches long spaced not more than 3 inches on centers.

7.7.1 Hook Strips: The lower edge of fascias shall be hooked at least 3/4-inch over a continuous hook strip of the same material bent outward at an angle of 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to

concrete or masonry, screws spaced 12 inches O.C. shall be used and shall be driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install hook strips in such a manner that vent slots are not obstructed. Where necessary, install hook strips over 1/16-inch thick compatible spacer or washers.

7.7.2 Joints: Section ends of gravel stops and fascias shall be left open 1/4-inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4-inches; set laps in plastic cement. Face nailing will not be permitted.

7.8 Gutters: The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Gutters shall be fabricated of zinc-coated steel, stainless steel, or cold-rolled copper. The outer edge of gutter shall be beaded or reinforced with a stiffening bar not less than 3/4 or 3/16-inch of material compatible with gutter. Gutters shall be fabricated in sections not less than 8 feet long. The sections shall be lapped a minimum of one inch in the direction of flow. Gutters shall be joined by riveted and soldered joints. Expansion-type slip joints shall be provided midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on approved type adjustable hangers spaced not more than 30 inches on centers. Gutters shall be adjusted to slope uniformly to outlets, with high points occurring midway between outlets. Hangers and fastenings shall be fabricated from metals compatible with the gutters.

7.9 Downspouts: The corrugated type, of the shapes and sizes indicated, and provided complete including elbows and offsets. Downspouts shall be provided in approximately 10-foot lengths; end joints shall telescope not less than 1/2-inches, and longitudinal joints shall be locked. Gutter outlets shall be provided with wire ball strainers of a standard type for each outlet. Strainers shall fit tightly into outlets and shall be of the same material used for gutters. Downspouts shall be kept not less than one inch away from walls and shall be fastened to the walls at top, bottom, and at not to exceed 5 foot centers intermediately between, with approved type leader straps or concealed rack-and-pin type fasteners; straps and fasteners shall be formed from metal compatible with the downspouts. Downspouts terminating in splash blocks shall be provided with elbow-type fittings. Splash blocks shall be concrete as specified in Section: Concrete.

7.10 Flashing at Roof Penetrations and Equipment Supports: Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors and similar items supported by or attached to the roof deck.

7.10.1 Single Pipe Vents: Flash with a 2-1/2 lb. minimum lead sleeve having a 4 inch flange. Set flange in bituminous plastic cement and nail 3 inches O.C. Top of sleeve shall be bent over and extended down into the vent pipe a minimum of 2 inches for long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, a two-piece formed metal housing of the specified sheet metal shall be used. Metal housing shall consist of a metal sleeve having a 4-inch roof flange set in bituminous plastic cement and nailed 3 inches O.C. Sleeve shall extend a minimum of 8 inches above the roof deck and shall be lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Area of hood in contact with vent pipe shall be sealed with an approved sealant. Sealants are covered under Section: CALKING.

7.11 Bitumen Stops: May be provided at eaves and rakes in lieu of felt envelopes. Bitumen stops shall be either (a) the rigid type with a 3/4-inch minimum vertical leg extending up into the gravel stops or (b) the folded type with a 3-inch minimum vertical leg folding back over the roofing felts. Provide bitumen stops in the form of a vertical sleeve 3 inches high with flange for all pipes projecting through roof. Horizontal flanges in bitumen stops shall be not less than 4 inches wide. Prior to installation of roofing felts, bitumen stops shall be nailed to wood nailers at not more than 3 inches on centers.

8. PAINTING: Sheet metal work shall not be field painted except as specified hereinafter and as required for the separation of dissimilar metals or for compliance with design requirements. Gutters, downspouts and accessories shall be painted in accordance with the requirements of the section entitled "Field Painting".

9. CLEANING: Clean all exposed sheet metal work at completion of installation. Grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris shall be removed, and the work scrubbed clean. All exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.

10. REPAIRS TO FINISH: Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Finish repaired surfaces shall be uniform and free from scratches, blemishes, and from variations of color and surface texture.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

	Copper, Ounces. Per Square Foot	Stainless Steel, Inch	Zinc Coated Steel, Gage
Downspouts and leaders	16	.015	24
Downspout clips & anchor	--	--	--
Downspout straisps, 2-inch	48(a)	.050	--
Downspout heads			
Scupper lining	20	.015	--
Strainers, wire diameter or gage	No. 9 ga.	.109 dia.	--
Gravel stops & fascias:			
Extrusions	--	--	--
Sheets, corrugated	16	.015	--
Sheets, smooth	20	.018	24
Edge strip	24	.025	--
Gutters:			
Gutter section	16	.015	24
Continuous cleat	16	.015	24
Hangers, dimensions	1"x1/8"(a)	1"x.037"	--
Cover plates	16	.015	24
Bitumen stops:			
Rigid	16	.018	24
Folded	20	.015	28

(a) Brass.

TABLE II. SHEET METAL JOINTS
TYPE OF JOINT

Item Designation	Copper, & Stainless Steel		Remarks
Gravel stops:			
Extrusions	--	Butt with 1/2" space.	Use sheet flashing beneath and a cover plate.
Sheet, smooth	Butt with space.	Butt with space.	Use sheet flashing back-up plate.
Sheet, corrugated.	Butt with space.	Butt with space.	Use sheet flashing beneath and a cover plate or a combination unit.
Gutters.	1 1/2" lap, rivited and soldered.		

SECTION 07951. CALKING

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

1.1 Federal and Military Specifications:

TT-C-598C & Int Am 3	Calking compound, oil and resin base type (for masonry and other structures).
TT-P-38D & Am 1	Paint, Aluminum, Ready Mixed.
TT-S-00227E & Int Am 3	Sealing compound; elastomeric type, two-component (for calking, sealing, and glazing in building construction).
TT-S-00230C & Int Am 2	Sealing compound; elastomeric type, single component, (for calking, sealing, and glazing in buildings and other structures).

2. SUBMITTALS:

2.1 Certificates: Submit certificates from the manufacturer attesting that the following products conform to all requirements of this specification and of reference documents:

Each type of calking compound or sealant

2.1.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference specifications listed:

MANUFACTURER AND PRODUCT

John Doe Company
Portland Cement, Type I

REFERENCE SPECIFICATION

ASTM C150-74, Type I.

SIGNATURE AND TITLE

2.2 Catalog Data: Submit complete descriptive literature for each type of each of the following items. Data which describe more than one type shall be clearly marked to indicate which type the Contractor intends to provide. Data shall be sufficient to show conformance to specified requirements.

Each type of calking compound

2.3 Colors: Submit one sample of each color of each of the following items for verification that products match the colors indicated. Where colors are not indicated, submit samples of the manufacturer's standard colors and patterns for selection by the Contracting Officer.

Each type of calking or sealant

4. DELIVERY AND STORAGE: Materials shall be delivered to the job site in the manufacturers' original unopened containers, with the brands, date of manufacture and name clearly marked thereon. All materials shall be carefully handled and stored to prevent inclusion of foreign materials, or subjection to sustained temperatures exceeding 90 degrees Fahrenheit. Calking compound shall be compatible with the material to and against which it is applied, and shall be of the nonstaining type. Sealants or calking compound more than six months old shall not be used.

5. GENERAL REQUIREMENTS:

5.1 Interior Calking shall be provided at all open joints exposed on the interior of the building.

5.2 Exterior Calking or Sealant shall be provided at all open joints and cracks exposed on the exterior of the building, in all areas requiring sealing to produce water- and weather-tight construction.

6. MATERIALS: Products shall conform to the reference documents listed and shall be of the type and class listed for each use.

6.1 Interior Calking: TT-C-598, Type I.

6.2 Exterior Calking or Sealant: Two-component, TT-S-227, Type II, Class A, or single-component, TT-S-230, Type II, Class A.

6.3 Primer for Elastomeric Sealants shall be a quick-drying, colorless, nonstaining sealer of type and consistency recommended by the sealant manufacturer for the particular application.

6.4 Bond Breakers shall be of the type and consistency recommended by the sealant manufacturer for the particular application.

6.5 Backstops: Glass fiber roving, or neoprene, butyl, polyurethane, vinyl or polyethylene foams free from oil or other staining elements, shall be used as backstops. Oakum and other type of absorptive materials shall not be used as backstops.

6.6 Primer for interior calking shall be ready-mixed aluminum paint, TT-P-38.

7. INSTALLATION:

7.1 Surface preparation: Surfaces against which primer and calking are to be applied shall be clean, dry to the touch, free from frost, moisture, grease, oil, wax, lacquer, paint or other foreign matter that would tend to destroy or impair adhesion. All joints shall be enclosed on three sides. Where grooves for adequate calking have not been provided, suitable grooves shall be cleaned out to the depth of 1/2-inch and ground to a minimum width of 1/4-inch without damage to the adjoining work. No grinding shall be required on metal surfaces. Where necessary to provide a suitable backstop, the back of joints over 1/2-inch in depth shall be packed tightly with an approved backstop material to within the depth of 1/2-inch from the surface. All loose particles shall be cleaned out just prior to calking and grooves given a uniform coating of primer. Primer shall not be applied to exposed finish surfaces. Bond breakers shall be provided as recommended by the sealant manufacturer for each type of joint and type of sealant used.

7.2 Application: The calking compound shall be applied in accordance with the manufacturer's printed instructions, using a gun with nozzle of proper size to fit the joint width. The compound shall be forced into grooves with sufficient pressure to fill the grooves solidly. Calking shall be uniformly smooth and free of wrinkles, and unless indicated otherwise, shall be tooled as necessary and left sufficiently convex to result in a flush joint when dry. Where the use of gun is impracticable, suitable hand tools may be used. The calking compound shall not be applied to joints when the air temperature is below 50 degrees Fahrenheit, or when it appears probable that temperatures below 50 degrees Fahrenheit will be encountered before the calking has set. The calking compound shall not be used when it becomes too gelled to be discharged in a continuous flow from the gun. Modification of the calking compound by addition of liquids, solvents, or powders shall not be permitted. Only the amount of calking which can be installed within four hours shall be mixed, but at no time, shall this exceed 5-gallon-unit increments. Calking around openings shall include the entire perimeter of each opening.

7.3 Protection and cleaning: Areas adjacent to joints to be filled shall be protected from smearing by the compound. Paper masking tape may be used for this purpose if removed 5 to 10 minutes after the joint section is filled. Fresh compound that has accidentally been smeared on masonry shall be scraped off immediately and rubbed clean

with methyl ethyl ketone, toluene or a similar solvent. Upon completion of calking all remaining smears, stains, and other soiling resulting therefrom shall be removed and work left in a clean and neat condition.

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DIVISION 8. DOORS, WINDOWS AND GLASS

SECTION 08110. HOLLOW METAL DOORS AND FRAMES

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

1.1 Federal Specifications:

HH-I-524B Int Am 1	Insulation Board Thermal (Polystyrene).
HH-I-530A Int Am 3	Insulation Board, Thermal (Polyurethane and Polyisocyanurate).
QQ-Z-325B Am 3	Zinc Coating, Electrodeposited.
RR-D-575B	Door, Metal, Sliding and Swing: Door Frame, Metal (Flush and Semi-flush).

1.2 American Society for Testing and Materials (ASTM) Publications:

D1621-73	Compressive Strength of Rigid Cellular Plastics, Test for.
D1622-63(1975)	Apparent Density of Rigid Cellular Plastics, Test for.
D1623-72	Tensile Properties of Rigid Cellular Plastics, Test for.
D2126-75	Resistance of Rigid Cellular Plastics to Simulated Service Conditions; Test for.

1.3 American National Standards Institute, Inc. (ANSI) Publications:

A115-1971	Specifications for Door and Frame Preparation.
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1.4 The Steel Door Institute (SDI) Publications:

SDI 100	Recommended Specifications - Standard Steel Doors and Frames.
SDI 107	Hardware on Steel Doors (Reinforcement-application).

2. QUALITY CONTROL: Approvals, except those required for field installations, field applications and field tests, shall be obtained before custom fabrication is started and before delivery of materials or equipment to the project site.

3. SUBMITTALS:

3.1 Tests and Certificates: The testing requirements for materials incorporated in referenced documents will be waived provided the Contractor submits certificates from the manufacturer stating that materials furnished

for this project conform to all requirements of this specification and the referenced documents. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

3.1.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and the respective reference specifications:

MANUFACTURER AND PRODUCT

John Doe Company
Hollow Metal Doors,
Extra Heavy Duty

REFERENCE SPECIFICATION

RR-D-575B, Type III

SIGNATURE AND TITLE

3.2 Catalog Data: Submit complete descriptive literature for each type of door and frame. Data which describe more than one type, size, model, or item shall be clearly marked to indicate which type, size, model, or item the Contractor intends to provide. Data shall be sufficient to show conformance to specified requirements.

3.3 Shop Drawings: Submit complete shop drawings for the doors and frames. Drawings shall indicate types, sizes, locations, metal gages, hardware provisions, method of glazing, installation details and other details of construction.

4. DELIVERY AND STORAGE:

4.1 Delivery: Doors, frames and accessories delivered to the site shall be inspected for damage, unloaded and stored in suitable and accessible spaces with a minimum of handling. During delivery, door frames of welded unit construction shall be strapped together in pairs with the head of one frame inverted for bracing. As an alternate method temporary steel spreaders shall be securely fastened to the bottom of each frame.

4.2 Storage: At the site, doors and frames shall be stored carefully on platforms under cover. The storage spaces shall be in dry locations with adequate ventilation, free from dust, or water, and shall

permit easy access for inspection and handling. The use of non-vented plastic or canvas shelters which create a humidity chamber shall be avoided. If the fiberboard wrapper on the door becomes wet, the carton shall be removed immediately. To promote air circulation, a 1/4 inch space shall be provided between the doors.

5. MATERIALS AND CONSTRUCTION: Hollow metal doors and frames of sizes, types, and designs indicated and specified herein shall be provided at openings shown on the drawings. Doors and frames shall conform to the requirements of RR-D-575, unless specified otherwise herein. Modify title of paragraph 3.2.9 in RR-D-575 to read "Type III, extra heavy duty, 1-3/4 inch". Doors and frames shall be prepared to receive the hardware specified under the Section entitled "Finish Hardware".

5.1 Hollow Metal Doors: Style of doors shall be 2. Doors shall be 1-3/4 inch thick, unless indicated or specified otherwise. All exterior doors shall be filled with insulation or plastic foam core panel reinforcement.

5.1.1 Type I (Standard Duty) Doors: Type I steel doors shall be provided where indicated and shall be manufacturer's extra standard duty type, of sizes and design indicated. Where provided, plastic foam core panel reinforcement shall be as specified herein.

5.1.2 Louvers and Moldings:

5.1.2.1 Louvers: Louvers for exterior doors shall have blades arranged to prevent the transmission of water. Louver blades shall be welded to or tenoned to frame and the entire louver assembly fastened to the door with moldings. Moldings located on the room or nonsecurity side of the doors shall be detachable. Molding located on the security side of the door shall be an integral part of the louver. Louvers shall be formed 16 gage steel for exterior doors and panels. In addition, louvers for exterior doors, where so indicated, shall have steel-framed insect screens secured to louvers in a rigid manner to permit ready removal. Wire cloth for screens shall be aluminum or galvanized steel 1/16 inch mesh. All louvers, before screening shall be designated to transmit a minimum of 35 percent free air.

5.1.2.2 Moldings: Moldings around louvered panels shall be of such design as to provide a rigid and secure installation. Panel moldings on the outside of exterior doors and on the corridor side of interior doors shall be non-removable. Other moldings around metal panels may be stationary or removable. Moldings on the inside of louver panels shall be secured to the stationary moldings and muntins with oval-head counter-sunk sheet metal or machine screws having small head. Muntins shall interlock at intersections and shall be fitted by coping or mitering and welded to stationary panel moldings.

5.1.3 Plastic Foam Panel Reinforcing: Plastic foam core panel reinforcement shall be by one of the following methods:

(a) A continuous rigid polyurethane plastic foam core, foamed-in-place or in board form bonded to the steel face sheets, and free of voids or other defects affecting its serviceability. The foam shall have the following properties when tested in accordance with the listed ASTM and visual test methods:

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Flammability	Grade 2	Fed. Spec. HH-I-530, Flammability Test
Density, core	1.8 lb/cu ft., min.	D1622
Compressive strength	20 psi, min.; at 10 % deformation or at yield point, whichever occurs first.	D1621, Procedure A
Tensile strength	20 psi, min., and not greater than foam to steel face sheet bond strength	D1623, Type B Specimen (board form polyurethane shall be bonded with adhesive used for bonding in door.)
Dimensional stability	plus or minus 5% volume change, max., and no visible distortion after 7 days exposure at -15 degrees F and 200 degrees F.	D2126, dimensions and visual examination measurements only
Holes and voids	No single hole or void larger than 1/4 inch in any direction, and no more than 8 holes up to 1/4 inch in size in any direction per 4 square feet of surface area.	Visual Examination

(b) A rigid, molded polystyrene plastic foam bead board core bonded to the steel face sheets with a thermosetting adhesive. The foam core shall have the following properties when tested in accordance with the listed ASTM, visual, or other indicated test methods.

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Flammability	AEB 60mm.max/ATB 50 sec. max*	Fed. Spec HH-I-524, Flammability Test
Density	1.0 lb. cu. ft., min.	D1622

Compressive strength	10 psi, min., at 10% deformation or at yield point, whichever comes first.	D1621, Procedure A
Tensile strength	18 psi, min., and not greater than foam to steel face sheet bond strength	D1623, Type B Specimen (Polystyrene foam shall be bonded with adhesive used for bonding in door.)
Dimensional stability	Plus or minus 5% volume change, max., and no visible distortion after 7 days exposure at -15 degrees F and 165 degrees F.	D2126, dimensions and visual examination measurements only.
Holes and voids	No single hole or void larger than 1/4 inch in any direction, and no more than 8 holes up to 1/4 inch in size in any direction per 8 square feet of surface area.	Visual examination
Bead fusion	Essentially fused bead structure indicated by an excess of broken or sheared beads.	Federal Specification HH-I-524, bead fusion test.

*AEB = Average Extent of Burning; ATB = Average Time of Burning.

5.2 Hollow Metal Frames: Frames shall be formed to sizes and shapes indicated, and shall have full welded unit or knock-down field assembled type construction at corners and other joints. Steel frames for doors shall be provided at locations shown on drawings.

5.2.1 Joints of Welded-Type Frames: Corner joints of frames for doors shall be mitered or butted and welded in accordance with the referenced requirements. All contact edges shall be closed tight. Welds on exposed surfaces shall be dressed flush and smooth and shall present a neat appearance.

5.2.2 Joints for Knock-Down Type Frames: Corner joints shall be designed for simple field assembly of header to jamb members by concealed tenons, splice plates, or other type of concealed interlocking joint, that will produce square and rigid corners and a tight fit. Joints shall be securely locked in place during erection and the alignment of adjoining members shall be maintained. Provide lock nuts for all bolted connections.

5.2.3 Anchors and Fasteners for Frames: Anchors shall be the manufacturer's standard shapes and sizes designed to anchor the frame securely to the adjoining construction. Anchors shall be of steel, zinc coated or painted with rust-inhibitive paint. Floor anchors shall be not lighter than 16 gage. Other anchors shall be not lighter than 18 gage.

5.2.3.1 Wall Anchors: A minimum of three anchors shall be provided for each jamb. Anchors shall be located opposite the top and bottom hinges and midway between top and bottom anchors.

(a) Anchors for fastening frames to masonry shall be adjustable, shall be corrugated or perforated, and shall extend not less than 8 inches into masonry.

5.2.3.2 Floor Anchors: Floor anchors shall be provided at the bottom of each jamb member. Anchors shall be adjustable and drilled for 3/8 inch diameter anchor bolts.

5.3 Provision for Installation and Locations of Hardware: Doors and frames shall be reinforced, drilled, and tapped to receive mortised finish hardware. Door and frame preparation for hardware shall be in accordance with the applicable requirements of ANSI A115 and SDI 107. Drilling and tapping for surface applied hardware shall be done at the project site and shall conform to SDI 107. Additional reinforcing of doors for surface applied hardware shall be built into the door at the factory. Hardware shall be located in accordance with the requirements of SDI 100, as applicable. Door frames shall be punched to receive a minimum of two rubber or vinyl door silencers on lock side of single doors, and one silencer for each leaf in heads of double door frames. Lock strikes shall be set out to provide clearance for silencers.

5.4 Factory Applied Undercoat on Steel:

5.4.1 Electrolytic Zinc-coated and Shop-primed Finish: Steel surfaces of hollow metal doors and frames shall receive an electrolytic zinc coating, a phosphate treatment, and a factory prime coat of rust-inhibitive paint. Zinc coating shall conform to QQ-Z-325, Type 1, except as modified herein. The zinc coatings on both sides of the metal shall have a total weight of 0.03-ounce per square foot. The phosphate treatment shall be the type standard with the manufacturer. The prime coat of paint shall be a type especially developed for materials treated by phosphate and adapted to application by dipping and spraying.

5.5 Construction and Workmanship: Finished doors and frames shall be strong and rigid, neat in appearance, free from defects, waves, scratches, cuts, dents, ridges, holes, warp or buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Exposed welded and soldered joints shall be dressed smooth. Door frame sections shall be designed for use with the wall construction indicated. Fastenings shall be concealed

where practicable. Frames in exposed masonry walls shall be designed to allow sufficient space between the inside back of trim and masonry to receive calking compound.

6. INSTALLATION:

6.1 Steel Frames: Frames shall be set accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. The bottom of frames shall be anchored securely to floors with expansion bolts or with power fasteners. Wall anchors shall be built-in or secured to adjoining construction as specified. Frames in masonry construction shall be backfilled with mortar.

6.2 Hinged Doors. Doors shall be hung in accordance with the clearances specified in RR-D-575. After erection and glazing, hardware shall be cleaned and adjusted.

7. PROTECTION: Doors and frames shall be protected from damage. Doors or frames that are damaged prior to completion and acceptance of the project, shall be repaired in a satisfactory manner, or replaced, as directed. Frames that have rusted shall be wire brushed until all rust is removed, cleaned thoroughly, and given an all-over coat of rust-inhibiting paint of the same type used for shop coat.

8. CLEANING: Upon completion, exposed surfaces of doors and frames shall be cleaned thoroughly. All mastic smears and other unsightly marks shall be removed.

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SECTION 08710. FINISH HARDWARE

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

1.1 Federal Specifications:

FF-H-106C/GEN	Hardware, Builders'; Locks and Door Trim: General Specification for.
FF-H-111C	Hardware, Builders'; Shelf and Miscellaneous.
FF-H-116E	Hinges, Hardware, Builders'.
FF-H-121D	Hardware, Builders'; Door Closers.

1.2 American National Standards Institute (ANSI):

A156.1-1970	Butts and Hinges (BHMA 101).
A156.2-1975	Locks and Lock Trim (BHMA 601).
A156.4-1972	Door Controls (Closers) (BHMA 301).
A156.7-1972	Template Hinge Dimensions (BHMA 111).

1.3 Builders' Hardware Manufacturers Association (BHMA) Standards:

1301, Dec 1973 Materials and Finishes.

2. QUALITY CONTROL: Approvals, except those required for field installations, field applications and field tests, shall be obtained before delivery of material to the project site.

3. SUBMITTALS:

3.1 Test and Certificates: The testing requirements for materials incorporated in referenced documents will be waived provided the Contractor submits certificates from the manufacturer stating that materials furnished for this project conform to all requirements of this specification and the referenced documents. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

3.2 Hardware Schedule: After approval of certificates; and before hardware is delivered to the job site, a hardware schedule shall be submitted and approved. The schedule shall include for each item the quantity, manufacturer's catalog number and corresponding reference publication type number, descriptive data, location, hardware set number, key control symbols, and list of abbreviations.

4. DELIVERY, STORAGE AND MARKING: Items of hardware shall be delivered to the job site in their original individual containers, complete with the necessary appurtenances including screws, keys, and

instructions. Each individual container shall be marked with the manufacturer's name and catalog number as they appear in the hardware schedule.

5. HARDWARE PRODUCTS:

5.1 General: As far as practicable, all locks shall be of one lock manufacturer's make, all hinges shall be of one hinge manufacturer's make; and all door-closing devices shall be of one door-closing device manufacturer's make. All modifications to hardware that are necessary to conform to the construction shown or specified shall be provided as required for the special operative and functional features. All builders' hardware indicated, specified, or necessary to completely equip the building shall be provided under this section.

5.2 Hardware Designations: Except as otherwise specified under "Hardware Sets", hardware items are specified by either federal designations or BHMA designations.

5.3 Template Hardware: Hardware to be applied to metal shall be made to template. The templates shall be furnished promptly to the metal door and frame manufacturer in order to avoid delay in door and frame manufacturing. Proper coordination shall be effected between the manufacturers of different hardware items in order that each manufacturer may furnish templates that will allow installation of hardware without interference with the installation and operation of other hardware. Dimensions of template hinges shall conform to ANSI A156.7.

5.4 Hardware Items: Hardware items shall conform to the specifications and standards listed and to the requirements specified herein. Hardware types, quantities, sizes, grades, and functions shall be as listed under "Hardware Sets". Where such data are not listed under "Hardware Sets", they shall be as specified herein.

5.4.1 Hinges: FF-H-116 and ANSI A156.1 Loose pin hinges for exterior doors and reverse-bevel interior doors shall be so constructed that the pins cannot be removed when the door is closed. Oil-impregnated bearing hinges may be provided in lieu of ball bearing hinges. Steel hinges for exterior doors shall have rust-resisting base plating under primer or other finish. Hinges shall bear the name or trademark of the manufacturer. Hinges shall be 4-1/2 by 4-1/2 inches unless otherwise specified under "Hardware Sets".

5.4.2 Locksets and Latchsets: FF-H-106 and ANSI A156.2. All locks and latchsets of the same series shall be the product of the same manufacturer. Lock cylinders shall have not less than 5 pin tumblers. Series 4000, Grade 1, locksets shall be provided.

5.4.3 Door Closing Devices: FF-H-121 and ANSI A156.4.

5.4.3.1 Surface Door Closers shall be provided complete with brackets, arms, mounting devices, and other features of the types required for the particular application. All surface closers shall have optional feature PT-4B unless otherwise specified.

5.4.4 Thresholds: ANSI A156.3. Thresholds shall be of extruded aluminum alloy or extruded bronze with satin finish, and shall have a wall thickness of not less than 0.125 inch. Thresholds shall have a fluted or ribbed top surface, supporting rib or ribs, and calking serrations, all extending the full length. Thresholds shall be in one piece, neatly cut to fit the particular opening and anchored in place with approved expansion shields and 1/4 inch diameter stainless steel screws, one at each end and intermediately spaced at not more than 12 inches on centers. Thresholds for exterior doors shall be set in a bed of calking compound conforming to section "Calking".

5.4.4.1 Latching Type Thresholds shall have an integral strike and stop 3/8 inch high, extending the entire length. Latching thresholds, for outswinging exterior doors shall be provided with a vinyl insert seal in the face of the stop.

5.4.4.2 Hook Strip Type Thresholds for inswinging exterior doors shall have an extended lip to receive a hook strip, extending the entire length. Hook strip shall be provided at the bottom of the doors and shall be of stainless steel strip not less than 0.005 inch thick, alloy 302, spring temper, and shall be fastened with stainless steel self-tapping screws at 1-1/2 inches on centers. Thresholds shall be of the water return type complete with weepholes to provide positive drainage to the exterior.

5.4.5 Weatherstripping shall be fabricated of extruded metal with vinyl or neoprene inserts, and shall be fastened with stainless steel screws 4 inches o.c. Weatherstripping shall provide a weathertight seal and shall permit complete closure of door without binding.

5.4.5.1 Sweep Strips shall be extruded bronze housings, not less than .070 inch thick with 1/8-inch by 1-3/8-inch neoprene insert. Bronze shall be finished to match door trim.

5.5 Keying System: The system shall be designed to provide the highest possible security consistent with the type of system being used. All pertinent keying requirements not specified herein shall be as directed by the Contracting Officer.

5.5.1 Keys shall be furnished as follows:

<u>Lock, Group or Set of Locks</u>	<u>Quantity of Keys</u>
Each Cylinder Lock (except keyed-alike locks)	2

Keys shall be suitable for fitting the master key for the specific area as directed by the Contracting Officer. Each change key shall be stamped with change number and set symbol, and each master key shall be stamped with set symbol as applicable. In addition, all keys shall be stamped "U.S. Property--Do Not Duplicate".

5.6 Fasteners: Fasteners of the proper type, quality, size, quantity and finish shall be supplied with the hardware. All fasteners exposed to the weather shall be of nonferrous metal or stainless steel and shall match the finish of the trim as closely as possible. Where hardware is of stainless steel, screws and fastenings shall also be of stainless steel. Fasteners shall be of the type necessary to accomplish a permanent installation.

5.7 Finishes: BHMA 1301. All hardware shall have BHMA 630 finish dull stainless steel or BHMA 626 finish dull chromium plated over brass or bronze. Surface type door closers shall have prime coat finish.

6. INSTALLATION OF HARDWARE:

6.1 General: All hardware shall be installed in accordance with manufacturer's instructions. Except as indicated or specified otherwise, fasteners furnished with the hardware shall be used to fasten hardware in place. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Use machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Use toggle bolts where required for fastening to hollow core construction. Use through bolts for mounting closers and pulls, and where necessary for satisfactory installation. After installation, protect hardware from paint, stains, blemishes and other damage until acceptance of the work. All hardware shall be adjusted properly and checked in the presence of an authorized Government representative, and all hinges, locks, latches, bolts, holders, closers and other items shall operate properly. After hardware is checked, keys shall be tagged, identified, and delivered to the Contracting Officer. All errors in cutting and fitting, and all damage to adjoining work shall be corrected, repaired and finished as directed.

6.2 Location of Hardware on Hinged Doors: Location shall be as follows, unless otherwise indicated or specified:

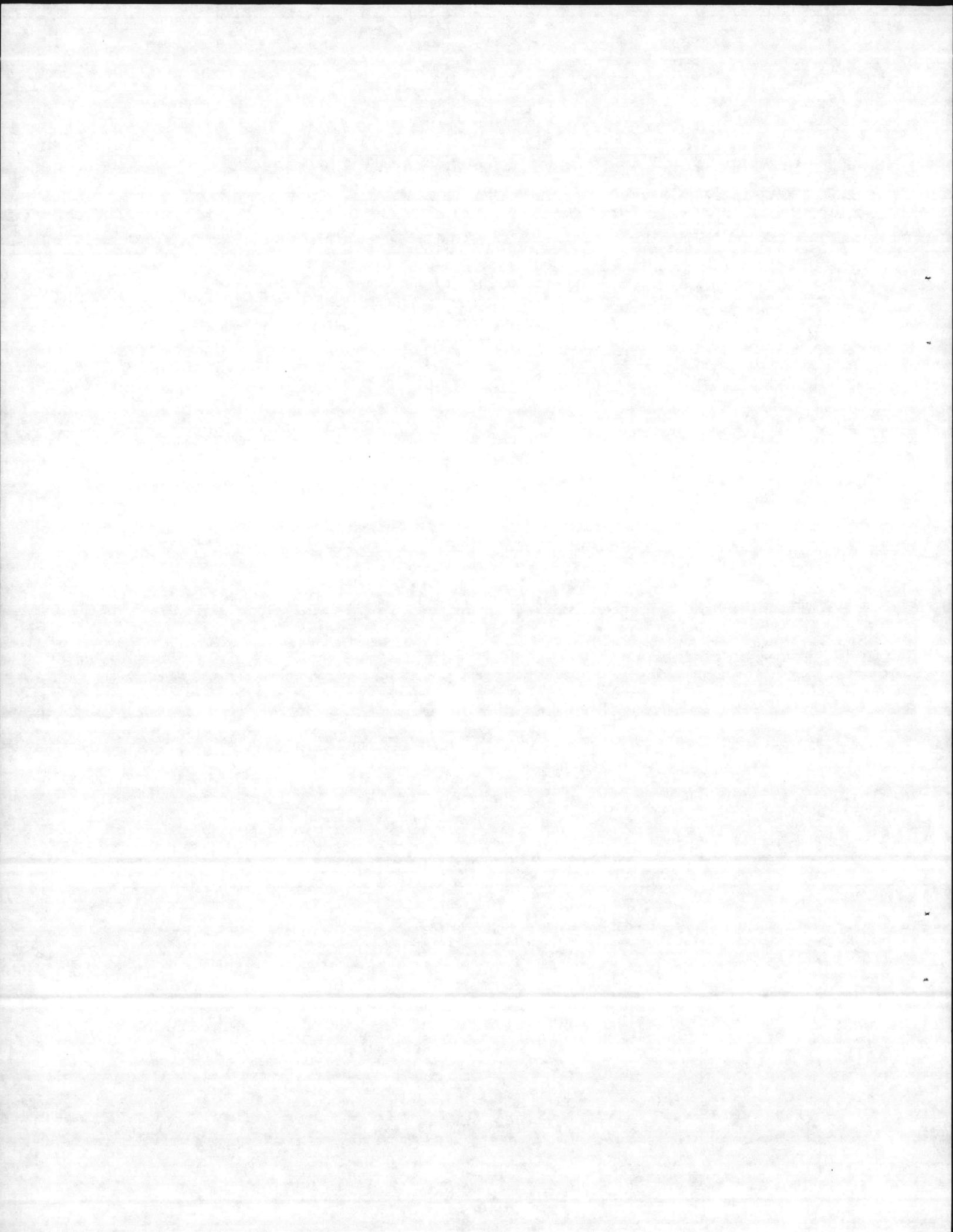
Locks, latches, roller latches and double handle sets	Centerline of lock strick 40-5/16" above floor
Top Hinge	11-3/4" from rabbet section of head of frame to centerline of hinge.
Bottom Hinge	13" from the finished floor to centerline of hinge.
Intermediate Hinge	Equally spaced between top and bottom hinge

7. HARDWARE SETS:

HW-1 (All doors)

1½ pair hinges	A 5112X630
1 Lockset	4000, Grade 1, F84
1 Closer	C01000, Type 1, 135° holder arm
1 Threshold	5" wide x 1/2" high

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SECTION 09910. FIELD PAINTING

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

1.1 Federal and Military Specifications:

TT-E-489F & Int Am 1	Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces).
TT-E-508B & Am 4	Enamel; Interior, Semigloss, Tints and White.
TT-E-543A & Am 1	Enamel, Interior Undercoat, Tints and White.
TT-F-1098D	Filler, Surface, Styrene-butadiene, Filler for Porous Surfaces (cinder block, Concrete Block, Concrete, Stucco, etc.)
TT-P-19C & Am 1	Paint, Acrylic Emulsion, Exterior.
TT-P-29J	Paint, Latex-Base, Interior, Flat, White and Tints.
TT-P-98C	Paint, Stencil, Flat.
TT-P-105A & Am 1	Paint, Oil, Chalk-resistant, Lead-free, Exterior, Ready-mixed, White and Tints.
TT-P-645	Primer, Paint, Zinc-chromate, Alkyd Type.
TT-P-00791B & Am 2	Putty: Linseed-oil, Type (for Wood-sash Glazing).
TT-S-176E	Sealer, Surface, Varnish Type, Floor, Wood or Cork.
MIL-S-12935D	Sealer, Surface, for Knots.
MIL-P-15328C & Am 1	Primer (Wash), Pretreatment Blue (Formula No. 117-B for Metals).
MIL-P-28582	Primer Coating, Exterior, Lead Pigment-free, (Undercoat for Wood, Ready-mixed, White and Tints).

1.2 Military Standard:

MIL-STD-101B & Am 1	Color code for pipelines and for compressed-gas cylinders.
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1.3 Federal Standard:

Fed. Std. 595a & Am 3	Colors.
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2. SUBMITTALS:

2.1 Tests and Certificates: The Contractor shall submit certificates from the manufacturer stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements in referenced specifications and that the material furnished for this project is of the same type, quality, manufacture, and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

2.1.1 Sample Certificate: The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced specification"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that previously manufactured materials have been tested by recognized laboratories, that such materials meet the requirements specified, that the materials being furnished for this project are of the same type, quality, manufacture, and make as those tested, and that the materials conform to all requirements of the respective reference specification:

MANUFACTURER AND PRODUCT

John Doe Company
Exterior Enamel No. 5
Interior Latex No. 6

REFERENCE SPECIFICATION

TT-E-489F
TT-P-29J

SIGNATURE AND TITLE

2.2 Approval of materials: No paint or other coating shall be applied before required test reports, certificates, and requests for substitutions have been submitted and the respective material approved for use on this project. All requests for substitutions shall be submitted to the Contracting Officer for approval. Each such request shall include specific identification of the proposed substitute, justification for the necessity of the substitution, certified test reports of the proposed substitute, including all tests required by the specification for the substituted material, and a tabulation of the specified material compared to the proposed substitute. The tabulation shall include all tests, composition of both pigment and vehicle, and quantitative and qualitative requirements required for both the specified and the proposed material; any deviations from specified requirements shall be clearly indicated. Any paints or other coatings that are applied before the paints or coatings are approved are subject to disapproval and, if so disapproved, shall be completely removed and surfaces restored to a condition suitable for specified paints or coatings.

3. DELIVERY AND STORAGE: Paints and paint materials shall be delivered in unbroken original packages bearing the manufacturer's name and brand designation, specification number, batch number, color, date of manufacture, and manufacturer's instructions for applications. Storage of paints and paint materials and the mixing of paints shall be restricted to the locations directed.

4. GENERAL REQUIREMENTS: Hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces and not to be painted shall be removed, masked, or otherwise protected prior to surface preparation and painting operations. Following completion of painting, removed items shall be reinstalled. Such removal and reinstalling shall be done by workmen skilled in the trades involved. Surfaces to be painted shall be thoroughly cleaned and, unless specified otherwise, shall be dry when paint is applied. Paint shall not be applied to surfaces upon which there is frost, ice, or snow. Interior areas shall be broom-clean and dust-free before and during the application of painting material. Wood and metal surfaces which will be inaccessible after erection shall be treated and primed prior to erection, using two coats of the designated primer. Painting materials shall be worked thoroughly into all joints, crevices, and open spaces. Succeeding coats of paint shall vary sufficiently in shade from the color of the preceding coat to permit ready identification. Finished surfaces shall be smooth, even, and free of defects. Damaged painting shall be retouched before applying succeeding coats of paint. Surfaces to be imbedded in concrete and factory-finished materials shall not be field-painted under this section, except that factory-finished surfaces which are damaged during installation shall be restored to their original condition. Reduction of paints to proper brushing consistency shall be accomplished by adding fresh paint; except that when thinning is mandatory for the type of paint being used, written permission to use thinners shall be obtained from the Contracting Officer. The written permission shall include quantities and types of thinners to use. Thinners shall not be permitted upon the job site unless written permission for thinning has been given by the Contracting Officer.

4.1 Selection of Colors: Colors of finish coats shall be as indicated. Where colors are not indicated the colors shall be as selected by the Contracting Officer from Fed. Std. No. 595.

5. PREPARATION OF SURFACES: Where existing surfaces have a film of oily substance, grease or other similar materials, the surface shall be washed clean with suitable detergent and allowed to dry before other surface preparation is started. All dirt, rust, scale, splinters, loose particles, (disintegrated paint,) grease, oil, and other deleterious substances shall be removed from all surfaces which are to be painted or otherwise finished. Putty and calking compound shall be allowed to set one week before painting. Existing enamel and other glossy surfaces shall have their entire surfaces sandpapered before application of any coatings. Surfaces shall be inspected and approved after preparation and before application of any coatings. Exposed nails and other ferrous metal on surfaces to be painted with water thinned paints shall be spot primed with zinc chromate primer, TT-P-645.

5.1 Defects in Existing Surfaces: Defects such as scratches, nicks, cracks, gouges, spalls, alligatoring, and irregularities due to partial peeling of previous paint coatings shall be repaired, smoothed,

sanded, spackled, or otherwise treated as necessary to render them practically invisible to the finished work. Where impracticable to satisfactorily eliminate the defects by other means, existing paint shall be removed from the entire surfaces, the surface repaired as necessary, primed, and repainted. Where peeling is general over an area, including self-contained portions of a surface, all paint in such area shall be removed and the edges of such removal shall be sanded out to provide imperceptible transition.

5.2 Wiping of Surfaces: After all other cleaning operations and wire brushing and sanding are completed, all previously painted surfaces that are to receive oil-based coatings, except stucco and similarly rough surfaces, shall be wiped down with clean rags saturated with mineral spirits and allowed to dry. Such wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

5.3 Wood Surfaces: Surfaces shall be free from dust and in an approved condition to receive the paint or other finish. The use of water on unpainted wood shall be avoided. Prior to application of paint, knots and resinous wood shall be treated with an application of knot sealer, MIL-S-12935. Puttying of cracks and nailholes shall be done after the priming coat has been applied and has dried properly. Any damage to previously painted interior wood surfaces shall be sandpapered over their entire area, and in addition shall be scraped as necessary to remove loose paint. All nail heads shall be set and putty stopped. Where checking of the wood is present, the surface shall be sanded down smooth, wiped, and a coat of pigmented orange shellac shall be applied and allowed to dry before further paint is applied. Open joints and all other openings shall be filled with whiting putty, TT-P-00791, and sanded smooth after it has dried.

5.4 Concrete and Masonry: Dirt, fungus, grease, and oil shall be removed prior to application of paint. New surfaces shall be washed with a solution composed of from 2 to 8 ounces of trisodium phosphate per gallon of hot water and then rinsed thoroughly with fresh water. Previously painted surfaces shall be washed with a suitable detergent and rinsed thoroughly. Glaze, all loose particles, and scale shall be removed by wire brushing. Efflorescence shall be removed by scraping, wire brushing and washing with a 5- to 10-percent by weight, solution of muriatic acid and then washed thoroughly with fresh water, removing all traces of the acid. All new surfaces to be painted with other than cement-water paint and chlorinated rubber-base paint shall be given a neutralizing treatment consisting of 2 pounds of zinc sulphate in one gallon of warm water. The neutralizer shall be applied liberally and allowed to dry, after which the surfaces shall be rinsed thoroughly with clean water and allowed to dry for not less than 48 hours before paint is applied.

5.5 New Metal Surfaces to be Painted, Except Hot Metal Surfaces: Surfaces, including aluminum, brass, copper, and zinc-coated surfaces and unprimed steel and iron surfaces, immediately after being cleaned, shall be given one coat of pretreatment coating, MIL-P-15328, applied to a dry film thickness of 0.2 to 0.5 mil. Zinc-coated surfaces to be painted shall be solvent cleaned with mineral spirits and wiped dry with clean dry cloths prior to application of pretreatment coating. Aluminum surfaces to be painted shall be treated with a hot 10-percent solution of chromic acid for 3 to 5 minutes and thoroughly rinsed with clean warm water prior to application of the pretreatment coating. Primer paint shall be applied over the pretreatment coating as soon as practicable after the coating has dried.

6. WORKMANSHIP AND APPLICATION:

6.1 Application: The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in colors. Coatings shall be applied carefully with good, clean brushes or approved spray equipment, except as specified otherwise. Areas made inaccessible to brushing by ducts and other equipment shall be sprayed. Spray equipment shall be the airless type. Approved rollers may be used for the application of latex coatings to interior walls and ceilings. The work shall be so conducted as to avoid contamination of other surfaces and public and private property in the area; any damage thereto shall be made good by the Contractor at his expense. Sufficient time shall be allowed between coats to permit thorough drying, and each coat shall be in proper condition to receive the next coat. Each coat shall be sufficiently heavy to cover completely the preceding coat or surface; there shall be an easily perceptible difference in shades of successive coats of paint. Exterior paint shall not be applied in foggy or rainy weather or when the temperature of the air or of the surface is below 45 degrees Fahrenheit or over 95 degrees Fahrenheit, unless approved by the Contracting Officer. Interior paint shall be applied when the surfaces to be painted are dry and the temperature can be kept above 45 degrees Fahrenheit during the application of ordinary paints, and between 65 degrees Fahrenheit and 95 degrees Fahrenheit during the application of enamels and varnishes. Paint shall not be applied when the surfaces are not in proper condition for painting.

6.2 Special Requirements for Painting Masonry and Concrete Surfaces With Acrylic Emulsion Paint:

6.2.1 Mixing of Fill Coat: The formula given in TT-P-19 for the content of the fill coat requires a definite amount of water to be added in preparation of the mixture. This requirement shall not apply. The sand, cement, and acrylic liquids shall be delivered preproportioned and packaged so that field proportioning will not be required. The acrylic liquid shall be field-mixed with the sand and cement, and after this mixture is thoroughly blended, water shall be added as necessary to produce a rich, creamy mixture of proper brushing consistency. The fill coat materials shall be mixed by hand but not vigorously agitated.

After mixing, it shall be allowed to set for ten minutes to permit air to escape before applying. The fill coat mixture will gradually thicken with time and addition of small amounts of water, and additional stirring shall be accomplished when necessary to keep the mixture a rich brushing consistency. Mixing shall begin not more than one hour before application.

6.2.2 Wetting of Surfaces: Before applying filler coat, the masonry and concrete shall be thoroughly wetted to control surface suction and provide a reserve of moisture to aid in curing the paint. A garden hose nozzle adjusted to a fine spray is adequate for the purpose. Dampening with a brush dipped in water is not acceptable. The masonry and concrete shall be dampened in one operation not more than one hour nor less than 30 minutes before painting. The spray shall be applied in such manner that each part is sprayed 3 or 4 times for about 10 seconds, time being allowed between applications for the water to soak into the surface. If the surface tends to dry rapidly, as in hot weather, it shall be redampened slightly just in advance of painting. The surface shall be moist but without free water when paint is applied.

6.2.3 Application: No painting shall be done when the paint may be exposed to temperatures below 40 degrees Fahrenheit within 48 hours after application or when temperature is over 95 degrees Fahrenheit. Paint shall not be applied during rainy weather or when the surfaces are not in proper condition for painting. The filler coat shall be rubbed into the surface in such a manner as to fill all depressions, holes, voids, joints, and hollows. The filler coat shall be applied with short, stiff fiber bristle brushes with bristles not longer than 2-1/2 inches, using a circular motion. After scrubbing in the filler coat so that all voids are filled, the surface shall be given a final stroke parallel to the course of block. Coverage shall be uniform and laps well brushed out. The first finish coat shall be applied at a rate of not less than one gallon per 250 square feet, and the second finish coat shall be applied at the rate of not less than one gallon per 300 square feet. Finish coats shall be brush applied, except that behind large ducts and similar locations inaccessible to a brush they may be applied by rollers. Spray application will not be permitted. All paint shall be delivered to the job site prior to application. The Contractor shall compute the amount of finish coat paint required and submit his calculations for approval. No painting shall be commenced until this amount has been approved and delivered to the job site. All delivered paint shall be applied. Paint shall be kept in tightly covered containers when not in use and shall be kept stirred to maintain uniform color and consistency during application. At least 24 hours shall lapse between coats and in no case shall another coat be started until the preceding coat has become so hard that it cannot be marked with the brushes used. In hot weather, the prior coat shall be slightly moistened before applying the succeeding coat. Covering is not necessary.

7. SCOPE: Exterior painting specifically includes all surfaces of the types listed including items mounted on or a part of the roofs. Surfaces concealed by portable objects and by articles mounted on the surfaces and readily detachable by removal of fasteners such as screws and bolts are included in the work but surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, equipment fixed in place, etc., are not included. Articles obstructing access to those surfaces specified to be included in the work shall be removed for access and restored to their original position on completion. Copper, stainless steel and aluminum will not require painting except where specifically so stated and except where surfaces have existing paint coatings. Work in concealed spaces is not required to be painted unless specifically so stated herein. Concealed spaces are defined as spaces above suspended ceilings, attic spaces, crawl spaces, furred spaces and chases. The paint coats specified herein are in addition to the coatings specified hereinbefore. Coatings have a lead content of over 1% by weight of nonvolatile content shall not be used. The surfaces to be painted hereunder include new surfaces and previously painted existing surfaces that are damaged during performance of work. New surfaces and existing surfaces made bare by cleaning operations shall receive the following coatings conforming to the respective specifications listed. Paints, primers, varnishes, enamels and undercoats shall be applied to a dry film thickness of not less than 1.0 mil each coat except as specified otherwise. Where coating thickness is specified it is the minimum dry film thickness.

7.1 Exterior Surfaces:

7.1.1 Wood and Plywood Surfaces:

One coat of primer, MIL-P-28582.
Two coats of paint, TT-P-105.

7.1.2 Concrete Masonry Surfaces:

One coat of acrylic fill coat, TT-P-19, modified.
Two coats of paint, TT-P-19.

7.1.3 Metal Surfaces:

Touch up shop prime coat on shop primed surfaces.
Primer, TT-P-645, two coats on surfaces not shop primed, one coat on shop primed surfaces.
Two coats of enamel, TT-E-489.

7.2 Interior Surfaces Except as Specified Otherwise: All softwood plywood shall receive one coat of sealer, TT-S-176, prior to receiving other coats.

7.2.1 Wood and Plywood Surfaces Not Specified Otherwise:

One coat of enamel undercoat, TT-E-543.
One coat of semigloss enamel, TT-E-503.

7.2.2 Metal Surfaces:

Touch up shop primer coat on shop primed surfaces.
One coat of primer, TT-P-645 on surfaces not shop primed.
One coat of enamel undercoat, TT-E-543.
One coat of semigloss enamel, TT-E-508.

7.2.3 Concrete Surfaces, except floors and interiors of concrete tanks:

Two coats of paint, TT-P-29.

7.2.4 Concrete Masonry Surfaces:

One coat of filler, TT-F-1098.
Two coats of paint, TT-P-29.

7.3 Surfaces in Toilets:

7.3.1 Wood Surfaces:

One coat of enamel undercoat, TT-E-543.
(One coat of semigloss enamel, TT-E-508.)
(One coat of gloss enamel, TT-E-506.)

7.3.2 Metal Surfaces:

Touch up shop primer coat on shop primed surfaces.
One coat of primer, TT-P-645, on surfaces not shop primed.
One coat of enamel undercoat, TT-E-543.
(One coat of semigloss enamel, TT-E-508.)
(One coat of gloss enamel, TT-E-506.)

7.3.3 Concrete Surfaces except floors:

One coat of paint, TT-P-29.
One coat of enamel undercoat, TT-E-543.
(One coat of semigloss enamel, TT-E-508.)
(One coat of gloss enamel, TT-E-506.)

7.3.4 Concrete Masonry Surfaces:

One coat of filler, TT-F-1098.
One coat of undercoat, TT-E-543.
(One coat of semigloss, TT-E-508.)
(One coat of gloss enamel, TT-E-506.)

7.3.5 Wallboard Surfaces:

One coat of sealer, TT-S-179.
One coat of enamel undercoat, TT-E-543.
(One coat of semigloss enamel, TT-E-508.
(One coat of gloss enamel, TT-E-506.)

7.4 Plastic Foam Insulation:

Two coats of paint, TT-P-19.

7.5 Cloth and Paper Covering on Insulation:

One coat of glue size.
One coat of suitable primer.
One finish coat to match adjacent surfaces.

7.6 Existing Surfaces Damaged During Performance of the Work including new patches in existing surfaces:

One coat of suitable primer.
One coat of undercoat or intermediate coat.
One finish coat to match adjacent surfaces.

7.7 Mechanical, Electrical, and Miscellaneous Metal Items, except hot metal surfaces and new prefinished equipment: Painting of new mechanical and electrical equipment is specified in the section covering the particular item.

Coating systems as specified hereinbefore.
Color of finish coat to match adjacent surfaces.

7.7.1 Surfaces Not Adjacent to Painted Surfaces:

One coat of primer, TT-P-645.
Two coats of enamel, TT-E-489.

7.7.2 All Above Ground Ferrous Piping:

One coat of pretreatment, MIL-P-15328, 0.3 to 0.5 mil.
Two coats of primer, TT-P-645.

7.7.3 Piping and Conduit Identification shall be provided, including surfaces in concealed spaces, and shall conform to MIL-STD-101, using black stencil paint, TT-P-98, for identification. Stenciling shall be placed in clearly visible locations. All piping and conduits not covered by the aforementioned standard shall be stenciled with approved names or code letters, not less than 1/2-inch high for piping and not less than 2 inches high elsewhere. Arrow-shaped markings shall be painted on the

lines to indicate the direction of flow. Two copies of the complete color and stencil codes used shall be provided.

7.7.4 Surfaces Not Requiring Paint: Zinc-coated ducts under insulation, and zinc-coated and copper pipe under insulation or in concealed spaces will not require painting.

7.8 Other surfaces for which the type of paint has not been specified hereinbefore shall be painted as specified for surfaces having similar conditions of exposure.

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SECTION 10201. WALL VENTS

1. GENERAL REQUIREMENTS: The work includes metal wall louvers. Louvers in metal doors are specified in section entitled "Hollow Metal Doors and Frames". Registers, grilles, diffusers, dampers and adjustable louvers are specified in section entitled "Ventilation".

2. BRICK WALL VENTS: Brick wall vents shall be cast aluminum masonry wall vents of the size indicated. The vents shall include a cast aluminum load bearing duct extension to provide a combined assembled length equal to the thickness of the masonry wall. Vent shall include 14 mesh aluminum insect screen and damper (sliding or pivoted). The unit sized to replace an 8 inch high by 16 inch long masonry unit shall have a minimum free area of 58 square inches.

3. INSTALLATION: Installation shall be in accordance with the manufacturer's published instructions except as indicated otherwise. All exposed screw heads shall be of the countersunk type.

4. QUALITY CONTROL:

4.1 Materials tests and test reports. The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture and make as that tested. Copies of the test reports need not be submitted except as specifically requested.

4.2 Shop drawings and manufacturer's literature showing all information necessary for fabrication and erection of louvers shall be submitted for approval. Drawings shall indicate materials, species, sizes, thicknesses, fastenings, and profiles. Materials shall not be delivered to job site until shop drawings and manufacturer's literature have been approved.

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DIVISION 15. MECHANICAL

SECTION 15011. GENERAL REQUIREMENTS, MECHANICAL

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

1.1 Federal Specifications (Fed. Spec.):

TT-E-489F & Am 1	Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces).
TT-E-496B & Am 2	Enamel, Heat-resisting (400 Degrees Fahrenheit), Black.
TT-P-28F	Paint, Aluminum, Heat Resisting (1200 Degrees Fahrenheit).
TT-P-645	Primer, Paint, Zinc-Chromate, Alkyd Type).

1.2 Military Specifications (Mil. Spec.):

DOD-P-15328D	Primer (Wash), Pretreatment (Formula No. 117 for Metals).
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1.3 American Society for Testing and Materials (ASTM):

B117-73A	Salt Spray (Fog) Testing.
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2. APPLICATION: This section applies to all sections of Division 15 of this project except as specified otherwise in the individual sections.

3. SUBMITTALS: Shop drawings, manufacturer's data and certificates for equipment, materials, finish, and pertinent details for each system shall be submitted and approved before procurement, fabrication or delivery of such items to the job site. Partial submittals are not acceptable and such submittals will be returned without review. Descriptive data shall be annotated to show the specific model, type and size of each item the Contractor proposes to furnish.

3.1 Shop Drawings: The drawings shall be a minimum of 8.5 by 11 inches in size, except as specified otherwise, and shall include plans, elevations, and sections of equipment and control spaces identifying and indicating proposed location, layout, and arrangement of items of equipment, control panels, accessories, piping, ductwork, and any other items that must be shown to assure a coordinated installation. Drawings also shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If any equipment is disapproved, drawings shall be revised to show acceptable equipment resubmitted.

3.2 Manufacturer's Data: Information shall be submitted for all material and equipment as specified in the individual sections that the Contractor proposes to furnish for accomplishment of the contract work. Submittals for each manufactured item shall be manufacturer's descriptive literature, diagrams, performance and characteristic curves, and catalog cuts, and shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, specification reference, applicable industry Federal and Military publications references, and all other information necessary to establish contract compliance.

3.3 Standards Compliance: Where equipment or materials are specified to conform to requirements of the standards of organizations such as American Society for Mechanical Engineers (ASME), Underwriters Laboratories (UL), American Gas Association (AGA) and American Refrigeration Institute (ARI) that use a label or listing as method of indicating compliance, proof of such conformance shall be submitted for approval. The label or listing of the specified organization will be acceptable evidence. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization adequately equipped and competent to perform such services, and approved by the Contracting Officer, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

3.4 Certified Test Reports: Where specified in the individual sections and before delivery of materials and equipment, certified copies of the reports of all tests required in referenced publications shall be submitted for approval. For materials for which certified test reports are not required in the individual sections, the testing requirements in referenced publications for materials will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture, and make as that tested; copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

3.5 Certificates of Compliance: Where specified in the individual sections, certificates from the manufacturer attesting that materials and equipment to be furnished comply with all requirements of this specification and of the reference publications shall be submitted for approval. The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certificate shall simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference publications listed:

MANUFACTURER AND PRODUCT	REFERENCE PUBLICATIONS
John Doe Company Gate Valve Model XYZ	WW-V-54D, Type III, Class A
	SIGNATURE AND TITLE

4. OPERATION AND MAINTENANCE MANUAL: An operation and maintenance manual for each mechanical system, except as otherwise specified herein, and for each piece of equipment shall be furnished by the Contractor. Three copies of the manual bound in hardback binders or an approved equivalent shall be provided to the Contracting Officer. One complete manual shall be furnished prior to the time that system or equipment tests are performed, and the remaining manuals shall be furnished before the contract is completed. The following identification shall be inscribed on the cover: the words "OPERATING AND MAINTENANCE MANUAL", the name and location of the equipment and the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and of the local representatives for each item of equipment and each system. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions cover the subject. The instruction sheets shall be legible and easily read, with large sheets of drawings folded in. The manual shall include, but not be limited to, the following: A system layout showing piping, valves, and controls; wiring and control diagrams with data to explain detailed operation and control of each component; a control sequence describing start-up, operation and shut-down; a detailed description of the function of each principal component of the system; the procedure for starting; the procedure for operating; shut-down instructions; installation instructions; maintenance and overhaul instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts list for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances provided.

5. POSTED OPERATING INSTRUCTIONS: Operating instructions approved by the Contracting Officer shall be provided for each system and each principal piece of equipment for the use of operation and maintenance personnel. The operating instructions shall include wiring and control diagrams showing the complete layout of the entire system, including

equipment, piping, and valves, and control sequence and shall be framed under glass or in approved laminated plastic and posted where directed by the Contracting Officer; printed or engraved operating instructions for each principal piece of equipment including start up, proper adjustment, operating, lubrication, shut-down, safety-precautions, procedure in the event of equipment failure, and any other necessary items of instruction as recommended by the manufacturer of the unit shall be attached to or posted adjacent to the piece of equipment. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

6. INSTRUCTION TO GOVERNMENT PERSONNEL: When specified in other sections, the Contractor shall furnish, without additional expense to the Government, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of mandays (eight-hours) of instruction furnished shall be as specified in other sections.

7. DELIVERY AND STORAGE: Equipment and materials shall be properly stored and adequately protected and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored, and protected in accordance with the manufacturer's recommendations and as approved by the Contracting Officer. Damaged or defective items, in the opinion of the Contracting Officer, shall be replaced at no cost to the Government.

8. CATALOGED PRODUCTS: Materials and equipment shall be essentially the cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall essentially duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name and address, and the model and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

9. SAFETY REQUIREMENTS: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any

person can come in close proximity thereto shall be fully enclosed or properly guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded, or covered with insulation of a type as specified under another section of this Division.

10. VERIFICATION OF DIMENSION: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

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

12. ELECTRICAL REQUIREMENTS: Electrical components of mechanical equipment, including motors and controllers, control wiring and conduit, shall be furnished with their respective pieces of equipment and shall conform to the requirements of the Division entitled "Electrical". Internal wiring for components of packaged equipment shall be provided as an integral part of the equipment. Extended voltage rangemotors will not be permitted. Controllers shall have a maximum of 120 volt control holding circuits. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. All interconnecting power wiring and conduit for field installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, and conduit and wiring connecting such center, assemblies or other power sources to mechanical equipment shall be provided under and conform to the requirements of Division entitled "Electrical".

13. PAINTING OF EQUIPMENT: Equipment painting, both shop and field applied, shall be as specified herein, and provided under the individual sections of this Division. It is desirable that all paint be shop applied; however, if the manufacturer's standard shop painting system does not meet these requirements, field painting shall be provided.

13.1 Field Painting: Aluminum surfaces shall not be painted. Dirt, rust, oil and grease shall be removed by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees Fahrenheit shall be cleaned to bare metal. Coatings shall be applied to clean and dry surfaces only. Where more than one coat of paint is specified, the second coat shall be applied after the preceding coat is thoroughly dry. Damaged painting

shall be retouched before applying the succeeding coat. Shop coats shall be lightly sanded before application of field applied coats.

13.1.1 Metal Surfaces Subject to Temperatures Less than 120 Degrees Fahrenheit: Surfaces shall receive: one coat of pretreatment primer conforming to Mil. Spec. DOD-P-15328 applied to a dry film thickness of 0.3 to 0.5 mil; one coat of primer conforming to Fed. Spec. TT-P-645 applied to a minimum dry film thickness of 1.0 mil; and two coats of enamel conforming to Fed. Spec. TT-E-489, applied to a minimum dry film thickness of 1.0 mil per coat.

13.1.2 Metal Surfaces Subject to Temperatures Between 120 and 400 Degrees Fahrenheit: Surfaces shall receive two coats of heat resisting enamel conforming to Fed. Spec. TT-E-496, Type II, applied to a total minimum thickness of 2 mils.

13.1.3 Metal Surfaces Subject to Temperatures Greater Than 400 Degrees Fahrenheit: Surfaces shall receive two coats of heat resisting aluminum paint conforming to Fed. Spec. TT-P-28 applied to a total minimum dry film thickness of 2 mils.

13.2 Optional Paint Systems: Manufacturer's standard equipment painting systems may be provided in lieu of the systems specified herein before provided the Contractor submits certification that the painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt spray fog test. Salt spray fog test shall be in accordance with ASTM B117, except that a 20 percent sodium chloride solution shall be used for the salt spray. Immediately after completion of the test, the paint shall show no signs of blistering, wrinkling or cracking; no loss of adhesion, and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory paint system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard painting system is being proposed for use in lieu of specified systems using Fed. Spec. TT-E-496 or TT-P-28, certifications that the manufacturer's standard system will conform to the heat resistance requirement of Fed. Spec. TT-E-496 or TT-P-28 as applicable, shall be submitted in addition to other certifications.

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SECTION 15181. INSULATION OF MECHANICAL SYSTEMS

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

1.1 Federal Specifications (Fed. Spec.):

HH-I-523C	Insulation Blocks and Pipe Covering, Thermal (Calcium Silicate)
HH-I-558B & Am 3	Insulation; Blocks, Boards; Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering; Thermal (Mineral Fiber, Industrial Type).
HH-I-1751/2	Insulation Sleeving, Thermal (Pipe Covering) Flexible Unicellular Glass
HH-I-1751/5	Insulating Sleeving, Thermal (Pipe Covering) Calcium Silicate.

1.2 Military Specification (Mil. Spec.):

MIL-A-3316B & Am 2	Adhesive, Fire Resistant, Thermal Insulation
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1.3 American Society for Testing and Materials (ASTM) Publications:

E84-77	Surface Burning Characteristics of Building Materials
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2. GENERAL REQUIREMENTS: Section 15011, General Requirements, Mechanical, applies to this section, with the additions and modifications specified herein.

2.1 Description of Work: The work includes providing new insulation for mechanical systems including piping, ductwork and equipment as specified herein. Materials and completed installation shall have a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84, except as specified herein. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the work "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. Vapor barrier will not be required on piping, ductwork and equipment used for heating only. Insulation material shall be installed in a first class manner with smooth and even surfaces, with jackets drawn tight and smoothly cemented down on longitudinal and end laps. Scrap pieces of insulation shall not be used where a full length section will fit. Insulation materials shall not be applied until surfaces to be covered are tested for leaks, cleaned and dried, and foreign material

such as rust, scale and dirt has been removed. Insulation shall be clean and dry when installed and during the application of any finish. Insulation shall be neatly finished at hangers. Insulation shall be continuous through hangers, sleeves, wall and ceiling openings. Provide a complete moisture and vapor seal wherever insulation terminates against metal hangers, anchors and other projections through insulation on cold surfaces for which a vapor seal is specified. Joints, breaks, punctures and voids shall be filled with vapor barrier compound and covered with vapor sealed material identical to that surrounding. Products containing asbestos will not be permitted.

2.2 Submittals Required: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists.

2.2.1 Manufacturer's Data:

- a. Insulation
- b. Jackets
- c. Adhesives, Mastic and Coatings

2.2.2 Certificates of Compliance:

- a. Insulation
- b. Jackets
- c. Adhesives, Mastics and Coatings

3. INSULATION FOR HOT WATER STORAGE TANKS AND CONVERTERS: Insulate with fibrous glass insulation conforming to Fed. Spec. HH-I-558, Form A, Class 1, minimum of 4 inches thick, minimum density of 6 pounds per cubic foot; or the calcium silicate insulation conforming to Fed. Spec. HH-I-523 or HH-I-1751/5, and having an insulation efficiency equal to that of the specified thickness of fibrous glass insulation. Secure block insulation with No. 16 gage, galvanized steel or copper clad wire or 0.75 inch wide, 0.015 inch thick galvanized bands, each spaced on 12 inch centers. Miter or score block to insure tight joints. Seal joints with insulating cement. Provide insulation with 0.5 inch thick hard-finish cement applied over zinc-coated wire netting; and finish with fibrous glass cloth jacket, smoothly adhered with lagging adhesive.

4. PIPING INSULATION: All new above ground pressure piping and existing above ground insulated piping affected by the Contractor's operations, except above ground piping specified in Section: Fuel Distribution Systems after being tested, shall be cleaned and insulated. Insulate fittings with the same material and thickness as adjacent runs of pipe. Pipe insulation shall be continuous through wall and floor openings, and pipe sleeves shall be sized accordingly. For hot piping inside building that is more than 6 feet above the floor, terminate the insulation immediately adjacent to each end of union, flanges, pressure regulating valve assemblies, trap assemblies, strainers, and valves.

Insulate pipe at hangers. For insulation protection shields Type 40; provide rigid pipe insulation of the same thickness as adjacent pipe insulation and having a minimum compressive strength of 35 psi or provide hardwood plugs having a minimum of one square inch bearing surface with the wood grain perpendicular to the pipe, between the insulation protection shield and the pipe; except insulation having a minimum density of 7 pounds per cubic foot may be provided between the insulation protector and the pipe for piping 2 inches and smaller. Install pipe insulation with all joints tightly butted. Overlap longitudinal jacket laps not less than 1.5 inches. Wrap butt joints with butt strips not less than 3 inches wide of identical material to jacket. Cement jacket laps and butt strips on both surfaces with adhesive conforming to Mil. Spec. MIL-A-3316, Class 2, or with factory applied self-sealing system. Staples shall be stainless steel, outside clinched without complete penetration of insulation. Where vapor barrier jacketing is pierced or punctured it shall be brush coated with vapor barrier coating to provide a vapor tight covering. For concealed hot piping, adhesive is not required when jacket is secured with flared staples on 4 inch centers. Where molded or mitered fitting covers are used they shall be joined with adhesive conforming to Mil. Spec. MIL-A-3316, Class 2 or wired in place and provide with a smoothing coat of finishing cement.

4.1 Pressure Piping Including Domestic Cold Water, Domestic Hot Water and Force Mains: Insulate with fibrous glass insulation conforming to Fed. Spec. HH-I-558, Form D, Type III, Class 12, minimum density of 3 pounds per cubic foot, provided with a factory-applied vapor barrier jacket. Rigid phenolic foam pipe insulation, minimum density of 2 pounds per cubic foot, with a factory applied vapor barrier jacket may be used in lieu of fibrous glass pipe insulation when pipe surface temperatures do not exceed 250 degrees Fahrenheit; and shall have a flame spread rating not to exceed 25, and a smoke developed rating not to exceed 50, as tested by the ASTM E84 method.

4.1.1 Domestic Cold Water and Domestic Hot Water Insulation shall be minimum of one inch thick.

4.1.2 Force Mains: Insulation shall be a minimum of two inches thick.

4.2 Insulation Covering Not Exposed to the Weather: Piping insulation shall be provided with manufacturer's standard fire retardant jacket; Contractor may use one piece premolded polyvinyl-chloride fitting covers with fibrous glass insulation inserts conforming to Fed. Spec. HH-I-558, Form B, Type 1, Class 8, same thickness as pipe insulation. Insulation exposed to the weather shall receive aluminum jacket.

4.3 Aluminum Jacket: New piping insulation and existing piping insulation affected by the Contractor's operations, exposed to the weather shall be provided with protective aluminum jacket with factory-applied polyethylene and kraft paper moisture barrier.

Aluminum jackets shall be corrugated and shall be not less than 0.016 inch thick. Jackets shall be secured with aluminum or stainless steel bands not less than 0.375 inch wide, or secured with aluminum or stainless steel screws; not more than 8 inches apart. Each jacket shall be applied by turning a one inch hem on one longitudinal edge and the hemmed edge turned in and lapped over the unhemmed edge. The jacket may be machine cut to produce a straight smooth edge and the hem omitted. The longitudinal and circumferential seams shall be lapped not less than 2 inches. Jackets on horizontal piping shall be installed with the longitudinal seam approximately midway between the horizontal centerline and bottom side of the pipe with top edge of the jacket overlapping the bottom edge of the jacket, with the seam of each jacket slightly offset from the seam of the adjacent jackets. The jackets on vertical lines and lines pitched from the horizontal shall be installed from low point to high point so that the lower circumferential edge of each jacket overlaps the jacket below it. Special fitting jackets conforming to the above with the exception of longitudinal lapping dimensions and location of seams shall be used for fittings, valves and flanges. Jackets for fittings, valves and flanges shall be properly overlapped and secured. Jackets shall be finished neatly at pipe hangers and shall be terminated neatly on the ends of unions, valves, traps and strainers. Equivalent aluminum jacketing system, when approved by the Contracting Officer, will be acceptable.

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SECTION 15301. EXTERIOR SANITARY GRAVITY SEWERS

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal Specifications:

RR-F-621b	Frames, covers, gratings, steps, sump and catch basin, manhole.
SS-P-356	Pipe, Bituminized Fiber and Fittings for.
SS-S-210A(1)	Sealing compound, preformed plastic, for expansion joints and pipe joints.
UU-P-268	

1.2 American Association of State Highway Officials (AASHO):

M 158-57	Bituminized-Fiber Drain and Sewer Pipe and Fittings.
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1.3 American Society for Testing and Materials (ASTM):

A74-72	Cast-iron soil pipe and fittings.
C 425-75	Compression joints for vitrified clay bell and spigot pipe.
C 564-70	Rubber gaskets for cast iron soil pipe and fittings.
C 700-75	Extra strength and standard strength clay pipe and perforated clay pipe.
D 2751-73	Acrylonitrile-Butadiene-Styrene (ABS) Plastic Utilities Conduit and Fittings
D 2680-76	ABS Composite Sewer Piping.

1.4 North Carolina Department of Transportation and Highway Safety:

"Standard Specifications for Roads and Structures", dated July 1, 1972.

1.5 LANTDIV Plates:

SS-3	Cleanout Detail.
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2. GENERAL REQUIREMENTS: Section 15011, General Requirements, Mechanical, also applies to this section except as specified otherwise. The work includes provision of sanitary gravity sewer piping and appurtenances outside of the limits bounded by the building five-foot line, the five-foot building line being a line drawn five feet outside of the outside face of building walls and parallel thereto. Sewer

pipng within building and within the five-foot building line is specified in the section entitled "Plumbing". Trenching and backfilling are specified in the section entitled "Earthwork". Concrete work shall be in accordance with the section entitled "Cast-In-Place Concrete", using concrete with a compressive strength not less than 3000 psi. Each system shall be complete and ready for operation. Piping shall be inspected, tested, and approved before being buried, covered, or concealed.

3. SUBMITTALS REQUIRED: Shop drawings, manufacturer's data and certificates for equipment, materials, finish, and pertinent details for each system shall be submitted and approved before procurement, fabrication or delivery of such items to the job site. Partial submission will not be acceptable. Descriptive data shall be annotated to show the specific model, type and size of each item the Contractor proposes to furnish. The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists.

3.1 Manufacturer's Data:

- a. Frames and Covers for Manholes
- b. Cleanouts
- c. Precast Manholes
- d. Adapters

3.2 Certificates: Submit certificates from the manufacturer attesting that each of the following items conform to all requirements of this specification and of reference publications.

- a. Pipe, and Pipe Fittings and Joints
- b. Frames and Covers for Manholes
- c. Precast Manholes
- d. Brick
- e. Masonry Units

4. MATERIALS:

4.1 Sanitary Gravity Sewer Piping: Except where cast iron is indicated or specified, piping shall be clay piping or ABS composite pipe.

4.1.1 Clay piping shall be extra-strength vitrified-clay pipe and fittings conforming to ASTM C700.

4.1.2 Cast-iron piping shall conform to ASTM A74, service weight.

4.1.3 Acrylonitrile-butadiene-styrene (ABS) plastic sewer pipe shall either be solid wall conforming to ASTM D 2751 for SDR 23.5 or pipe made with ABS inner and outer walls joined by a truss shaped extrusion pipe. Truss pipe voids shall be filled with a light-weight concrete. Pipe shall conform to ASTM D 2680.

4.2 Pipe Joints:

4.2.1 Clay Pipe: Joints in clay pipe and fittings shall be compression joints conforming to ASTM C425.

4.2.2 Hub and spigot cast-iron pipe: Joints to hub and spigot cast-iron pipe and fittings shall conform to ASTM C564. The piping shall be as specified hereinbefore, except for dimensional modifications to the hub and the spigot end to suite the gasket. The gasket shall be furnished with the pipe and shall be the same class as the pipe in which it is installed.

4.2.3 ABS pipe joints shall be solvent weld type as recommended by the manufacturer and special care shall be used in connecting ABS pipe into manholes. The manufacturer's recommendations for connecting into manholes shall include provisions for maintaining flexibility, longitudinal expansion/contraction of pipe and watertightness.

4.2.4 Joints between dissimilar types of pipe shall be made with manufacturer's standard adapters manufactured for connecting dissimilar types of pipe. Adapters shall be of polyvinyl chloride (PVC) or rubber, and shall be provided with stainless steel clamps with stainless steel take-up bolts for attaching to each end of the pipe.

4.3 Cleanouts shall be in accordance with LANTDIV Plate SS-3, which appears at the end of this section, and shall be constructed of cast-iron soil pipe and fittings conforming to ASTM A74. Cleanout plugs shall be heavy brass, bronze or thermo-plastic with recessed removal plug.

4.4 Perforated Pipe:

4.4.1 Piping used for drainfield systems (including wash apron drainfield systems) and underdrains where indicated shall be bituminized-fiber pipe composed of a bituminous compound reinforced with an interwoven fibrous structure. The fibrous material shall be thoroughly impregnated with the bituminous compound. Perforated pipe shall conform to Federal Specification SS-P-356 and Standard Specification AASHO M 158-57.

4.5 Filter material for underdrains and drainfield construction shall be crushed stone conforming to section entitled "Earthwork".

4.6 Frames and covers for septic tank shall conform to RR-F-621, Figure 4, Size 22, for frame and Figure 12, Size 22 for cover in non-paved areas. Frames and covers shall be factory coated with asphalt based paint.

5. INSTALLATION:

5.1 Pipe Laying: Pipe shall be inspected in the sling and approved before lowering into the trench. Defective, damaged, or unsound pipe will be rejected. Batterboards shall be provided not more than 25 feet apart in trenches for checking and insuring proper pipe slope and elevation. Laser beam method may be used for insuring proper slope and elevation in lieu of batterboards. Except where other necessary for making connections with other piping, pipe shall be laid with hubs or bells facing in the direction of the laying. Where cutting of the pipe is necessary, it shall be done with approved mechanical cutters in a manner that will not damage the pipe. The full length of each section of pipe shall rest solidly upon the pipe bed with recesses excavated to accommodate the bells, hubs, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being laid in the trench and shall be kept clean during laying operations by means of plugs or other approved methods. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water or other foreign substance will enter the pipes or fittings.

5.2 Joints: Pipe joints shall be of the types specified hereinbefore. Except as specified otherwise, joint installation shall follow the printed instructions of the pipe manufacturer. Adapters shall be installed in accordance with the printed instructions of the adapter manufacturer.

5.3 Connections to existing sanitary systems: The Contractor shall furnish all material and labor required to make connections into the existing sanitary systems; and shall perform all necessary excavating, backfilling, and other labor as required. Where new manholes are constructed on existing lines, the existing pipe shall be removed as required to properly construct the structures. The pipe shall be cut or broken neatly so that the pipe ends will be approximately flush with the interior face of structure walls, but not protruding beyond such face into the structure. The pipe to wall connections shall be mortared smoothly and provided with a flexible preformed rubber or PVC "boot" to produce smooth transitions and watertight connections. The Contracting Officer shall be notified in writing at least ten days prior to the date the connections are required. Approval by the Contracting Officer shall be received before any service is interrupted.

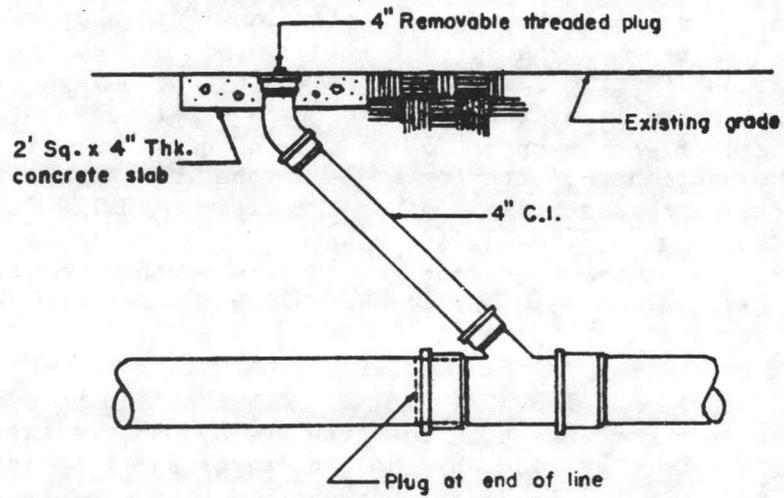
5.4 Installation of perforated Pipe: Drain lines shall be graded uniformly downward to their outlets to the elevations indicated. Care shall be taken that perforated pipe is laid with the perforations in the position indicated. Filter media of crushed stone shall be placed around and over the drain pipe as indicated. Special care shall be taken when placing the filter media to prevent displacement of and injury to the drain pipe. Where indicated, filter media shall be covered with a layer of Kraft paper, Grade B, No. 2, 50-pound weight, conforming to UU-P-268, or 2 inches of straw. The trenches shall then be backfilled with compacted earth fill. Grade boards shall be provided for the installation as shown, and shall be No. 1 southern pine, pressure treated

with coal tar creosote in accordance with Standard C2-74 of the AWWA "Book of Standards" as specified therein for soil contact. Stakes shall be provided to support grade boards and shall be of the material and preservative treatment as specified for grade boards. Nails shall be galvanized.

5.5 Warning Tapes in Earth Trenches: For the purposes of early warning and identification of buried pipes during future trenching or other excavation continuous identification tapes shall be provided in the trench. Tape shall be non-magnetic plastic tape or aluminum foil plastic backed tape manufactured for the purpose of early warning and identification of utilities buried below the tape. Tape shall be at least three inches in width. Color of tape shall be as standard with the manufacturer with respect to the type of utility buried below the tape. Tape shall have lettering at least one inch high with not less than the following identification on the tape: "BURIED SEWER LINE BELOW". Tape shall be installed in accordance with the printed recommendations of the tape manufacturer, as modified herein. Tapes shall be buried at a depth of 6 inches below the top surface of earth; in pavements this 6 inches shall be measured from the top of the subgrade.

6. TESTING AND INSPECTION: All work shall be proved to be constructed in accordance with the drawings and specifications. All defects in the work provided by the Contractor shall be corrected by him at his own expense. A light held at one end of the piping shall show a partially full circle of light through the pipe when viewed from the adjoining manhole or end of the piping. Piping shall be tested for infiltration by means of a suitable weir or other device. When determination of infiltration is not practicable because of dry trench conditions, an exfiltration test shall be performed by filling the piping with water so that the head will be at least 4 feet above the crown of the upper end of the section being tested. The amount of leakage (infiltration or exfiltration) shall not exceed 200 gallons per inch of diameter per day per mile of pipe.

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CLEANOUT DETAIL
NOT TO SCALE

LANTDIV PLATE SS-3

05-82-4643
15301 - 6

SECTION 15401. PLUMBING

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

1.1 Federal Specifications:

W-H-196J & Am 1	Heaters, Water, Electric and Gas Fired, Residential.
GG-G-76D	Gages, Pressure and Vacuum, Dial Indicating.
GG-T-321C & Am 1	Thermometers, Self-Indicating, Liquid in Glass for Machinery and Piping Systems.
WW-N-351C	Nipple, Pipe, Threaded.
WW-P-421D	Pipe, Cast Gray and Ductile Iron, Pressure.
WW-P-541D/GEN & Am 1	Plumbing Fixtures (General Specification).
WW-P-541/1A & Am 1	Plumbing Fixtures (Water Closets) (Detail Specifications).
WW-P-541/4A	Plumbing Fixtures (Lavatories) (Detail Specifications).
WW-U-531E	Unions, pipe, steel or malleable iron (Threaded Connection).
WW-V-51F	Valves, Bronze; Angle, Check and Globe (125, 150 and 200 Pound; Threaded, Flanged and Solder).
WW-V-54D & Am 3	Valves, Bronze, Gate (125, 150, and 200 Pound; Threaded, Flanged and Solder).
WW-V-58B	Valves, Gate, Cast-Iron, Threaded and Flanged.

1.2 Military Specifications:

MIL-T-12295D	Tanks, Hot-Water Storage.
MIL-H-12322D	Heaters, Water; Steam and Hot-Water Heated.
MIL-V-13612D	Valves, Relief, Pressure and Temperature (For Hot Water Supply Systems).
MIL-S-16293F	Strainers, Sediment, Pipeline.
MIL-V-18146B	Valves, Pressure Regulating, Water.
MIL-V-18433B	Valves, Temperature Regulating (Thermostatically Controlled).
MIL-V-18436D	Valves, Check; Bronze, Cast-Iron and Steel Body.
MIL-V-18826B	Valves, Globe and Angle, Cast Iron.

1.3 American National Standards Institute (ANSI):

A21.10-77	Gray-Iron and Ductile-Iron Fittings, 2-Inch through 48-Inch.
A21.11-72	Rubber Gasket Joints for Gray-Iron and Ductile-Iron Pressure Pipe and Fittings.
B16.1-75	Cast-Iron Pipe Flanges and Flanged Fittings.
B16.5-77	Steel Pipe Flanges, Flanged Valves and Fittings.
B16.18-78	Cast-Bronze Solder-Joint Pressure Fittings.

- B16.22-73 Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- B16.23-76 Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- B16.29-73 Wrought Copper and Wrought Copper Alloy Drainage Fittings.

1.4 American Society for Testing and Materials (ASTM):

- A53-78 Welded and Seamless Steel Pipe.
- A74-75 Cast-Iron Soil Pipe and Fittings.
- A120-77 Black and Hot Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe.
- A126-73 Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- B88-76 Seamless Copper Water Tube.
- B306-76 Copper Drainage Tube (DWV).
- C564-70 Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.

1.5 American Water Works Association (AWWA):

- C203-78 Coal Tar Enamel Protective Coatings for Steel Water Pipe Lines, Enamel and Tape, Hot Applied.
- C600-77 Installation of Cast Iron Water Mains.
- C601-68 Disinfecting Water Mains.
- D100-73 Welded Steel Water Tanks
- D102-64 Painting & Repainting Steel Tanks

1.6 Cast-Iron Soil Pipe Institute (CISPI):

- 310-78 Patented Joint For Use in Connection with Hubless Cast Iron Sanitary System.
- 301-78 Hubless Cast Iron Sanitary System with Cast Iron No-Hub Pipe and Fittings.

1.7 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

- SP-58-75 Pipe Hangers and Supports - Materials, Design and Manufacture.
- SP-69-76 Pipe Hangers and Supports - Selection and Application.

1.8 National Fire Protection Association (NFPA):

- 24-77 Outside Protection.

1.9 Southern Building Code Congress:

- 1979 Standard Standard Plumbing Code

2. GENERAL REQUIREMENTS: Section 15011, General Requirements, Mechanical, with the following additions and modifications, applies. The work includes providing new plumbing systems and related work.

Installation and workmanship shall be in accordance with the Standard Plumbing Code except as specified or indicated otherwise; the permissive provisions shall be considered to be mandatory as though the word "shall" had been substituted for the word "may" wherever it appears, and reference to the "plumbing official" and the "design engineer" shall be interpreted to mean the Contracting Officer. Capacity and efficiency of equipment shall be not less than that indicated. Plumbing systems shall be connected to building service piping. Plumbing systems shall include all piping buried and above ground except sanitary, roof drainage and water piping more than five feet outside of the building walls are specified in the sections entitled "Exterior Sanitary Gravity Sewers", "Storm Drainage Systems", and "water Distribution". Contractor shall rough-in for and shall make final plumbing connections to equipment furnished under other sections of this specification.

3. SUBMITTALS REQUIRED: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists. Items in the following lists (which are followed by (CO)) shall be approved by the Contracting Officer.

3.1 Manufacturer's Data:

- a. Pipe and Fittings
- b. Valves
- c. Plumbing Fixtures
- d. Hot Water Heaters (CO)
- e. Pipe Hangers (CO)
- f. Pressurization System
- g. Water Storage Tank

3.2 Shop Drawings:

- | | |
|--------------------------|--------------------------|
| a. Pipe and Fittings | e. Pipe Hangers |
| b. Valves | f. Pressurization System |
| c. Plumbing Fixtures | g. Water Storage Tank |
| d. Hot Water Heater (CO) | |

3.3 Certificate: Submit certificate from the manufacturer attesting that each of the following items conform to all requirements of this specification and of reference publications.

- a. Pipe and Fittings. b. Valves

4. SANITARY DWV (DRAIN, WASTE AND VENT) PIPING: Fittings shall be long radius fittings, except those in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for above ground piping.

4.1 Buried Piping: Shall be one or more of the following materials.

4.1.1 Cast Iron Hub and Spigot Pipe and Fittings: ASTM A74, Service SV, with calked and lead joints or rubber gasket joints (ASTM C564).

4.2 Above Ground Piping: Shall be one or more of the following materials.

4.2.1 Cast Iron Piping: Shall be as specified in paragraph entitled Buried Piping.

4.2.2 Steel Pipe: ASTM A53 or A120, standard weight, zinc coated, threaded pipe with zinc coated, threaded fittings (ANSI B16.12).

4.2.3 Copper Tubing: ASTM B88 hard drawn or B306, with solder joint fittings (ANSI B16.23).

4.3 Cleanouts:

4.3.1 Floor Cleanouts: Cast-iron with ductile drainage flange with polished bronze rim and scoriated floor plate with C.O. cast in plate and secured to internal raised head by countersunk screw.

4.3.2 Wall Cleanouts: Cast-iron with brass screw plug with polished stainless steel or chromium plated bronze cover plate attached to plug by countersunk screw.

4.3.3 Cleanouts in Exterior of Building: ASTM A74 or CISPI 301 and 310. Cleanout plugs shall be heavy brass, bronze or thermo-plastic with recessed removal plug.

5. DOMESTIC WATER PIPING:

5.1 Buried Piping: Sizes less than 3 inches shall be copper tubing. Sizes 3 inches and larger shall be mechanical joint cast-iron piping with cement mortar lining.

5.1.1 Copper Tubing: ASTM B88 hard drawn, Type K, with solder joint fittings (ANSI B16.18 or B16.22) or flared joint fittings (ANSI B16.26).

5.1.2 Cast Iron Pipe: WW-P-421, Thickness Class 23 for gray cast iron, Thickness Class 52 for cast ductile iron, with mechanical joint fittings (ANSI A21.10 and A21.11), cement mortar lined pipe and fittings.

5.2 Above Ground Piping: Shall be one or more of the following materials.

5.2.1 Copper Tubing: ASTM B88 hard drawn, Type K or L, with solder joint fittings (ANSI B16.18 or B16.22).

6. WATER VALVES: Provide with stems horizontal or above.

6.1 Sizes 2 Inches and Smaller: Threaded end connections, except solder end connections may be used for connections to copper tubing.

6.1.1 Gate Valves: WW-V-54, Class A.

6.1.2 Globe and Angle Valves: WW-V-51, Class A.

6.1.3 Check Valves: WW-V-51, Class A, Type IV.

6.2 Sizes 2.5 Inches and Larger: Flanged end connections. Cast iron components shall conform to ASTM A126, Grade B or C.

6.2.1 Gate Valves: WW-V-58, Class 1.

6.2.2 Globe and Angle Valves: WW-V-18826, Class 125.

6.2.3 Check Valves: MIL-V-18436, Class 125, non-slam swing type.

6.3 Water Pressure Regulating Valves: MIL-V-18146, Type I.

6.4 Water Pressure and Temperature Relief Valve: MIL-V-13612, Type I, with test lever.

6.5 Hose Bibbs: Bronze body with hand wheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.

6.6 Non-Freeze Wall Hydrants: Angle type globe valve with lockshield. Bonnet and seat assembly shall be removable from outside of the building. Hydrant shall be of sufficient length to extend through walls and place valve seat inside the building or in the crawl space. Hydrant shall have vacuum breaker with 0.75 inch external hose threads. Hydrant shall be constructed of bronze, copper or brass. Exposed surfaces of hydrant shall be nickel-plated, except hand-wheel may be painted. Valve seat shall be bronze or nylon. Disc shall be Buna-N, brass or bronze.

7. MISCELLANEOUS PIPING MATERIALS:

7.1 Pipe Nipples: WW-N-351, except material shall be brass or bronze for copper tubing.

7.2 Unions: ANSI B16.18 or B16.22 for copper tubing, and WW-V-531, Class 1, Style B, for steel piping.

7.3 Flanges: ANSI B16.1, Class 125, or ANSI B16.5 Class 150.

7.4 Escutcheon Plates: One piece or split hinge type, pressed steel, chromium plated.

7.5 Dielectric Connections: Provide at all connections between ferrous and nonferrous piping materials.

7.6 Pipe Hangers and Supports: MSS SP-58 and SP-69, Type 1 or 6, except as specified or indicated otherwise. Insulated piping shall have insulation protection shields Type 40. Support rods shall be steel. Finish of materials shall be zinc or cadmium plated, except for uninsulated copper tubing the finish shall be copper plated. Piping insulation is specified in section entitled "Insulation of Mechanical Systems".

7.7 Strainers: MIL-S-16293, Class 125, Style Y, and shall have blow off outlet with pipe nipple and gate valve.

7.8 Gages: GG-G-76, Class 1, Style X, Type I, with 4.5 inch dial, brass or aluminum case, bronze tube. Scale range shall be suitable for the intended service.

7.9 Thermometers: GG-T-321, Type II, Class 3. Scale range shall be suitable for the intended service.

8. FIXTURES, FITTINGS, ACCESSORIES, AND SUPPLIES: WW-P-541, except as specified otherwise. Provide stop valves in each supply to each fixture. The finish of pipe, fittings and accessories exposed to view shall be chromium-plated. Plastic or zinc-alloy handles will not be permitted for faucets and valves.

8.1 Tank Type Water Closets: WW-P-541/1, floor mounted, siphon jet, regular bowl, water conservation type, and white solid plastic regular closed front seat with cover. Non-float swing type flush valves are not acceptable.

8.2 Lavatories: WW-P-541/4, enameled cast-iron, wall hung, straight back minimum dimensions of 19 by 17 inches, copper alloy combination faucets, flow control devices, pop-up drain fittings, adjustable P-trap, concealed wall hanger with thru-bolts and back-plates for mounting.

9. DRAINS:

9.1 Floor Drains: Shall be cast-iron with double drainage flange and weepholes, with perforated or slotted cast brass or bronze strainer, adjustable collar, P-trap, and clamping rings for use with membrane waterproofing. Drains of sizes 2, 3 and 4 inch shall have 5, 7 and 9 inch diameter strainers, respectively.

10. DOMESTIC WATER HEATERS: W-H-196, electric water heater, cement or glass lined tanks. Tanks shall be insulated with 2 inch thick fibrous glass insulation, with exterior metal jacket with backed enamel finish.

10.1 Storage Tanks: MIL-T-12295, Type II or IV, Class 1, Style B.

10.2 Water Heaters: MIL-H-12322 and shall be suitable for use with the storage tanks specified hereinbefore. Heating shall be hot water.

10.3 Water Temperature Regulating Valves: MIL-V-18433.

11. PACKAGE PRESSURIZATION SYSTEM for Site VIII-1 shall be a hydraulic system which pressurizes the water system and controls the operation of the pressurization pump. The package system shall consist of dual storage cells, pressure regulating valve, pressure gauge and pressurization pump. The entire package shall be provided with all brackets and fasteners needed for mounting the pump on the storage cells and all hoses and fittings for connecting the pump to the cells.

11.1 The storage cells shall incorporate an elastic membrane which shall alternately store and release water in response to the pressure variations in the system. The cells shall have a minimum two gallon capacity and shall be suitable for a maximum pressure of 75 pounds per square inch. The cells shall be such that they shall maintain pressure on the system when there is no demand.

11.2 The pressure regulating valve shall be cast iron or bronze and shall be comprised of a spring loaded diaphragm and a special flow control valve seat which shall control a pressure switch. The pressure regulating valve in conjunction with the storage cells shall regulate the operation of the pressurization pump. The pressure switch shall operate the pump and maintain pressures in the system between 30 and 50 pounds per square inch.

11.3 Pressurization pump shall be a convertible self-priming jet pump meeting the requirements as shown. Pump shall be of corrosion resistant construction and shall be provided with a forged brass impeller. Pump shall be controlled by the pressure switch specified above. Pump suction piping shall be connected to the potable water storage tank specified hereinafter.

11.3.1 Provide one complete spare pressurization pump for storage at the site. Spare pump shall be provided with the pump to be placed in service.

12. WATER STORAGE TANK: The Contractor shall provide at Site VIII-1 a new water storage tank indicated. The Contractor shall provide all piping and valving as required.

12.1 The water storage tank shall be a horizontal steel tank designed for the storage of water at atmospheric pressure. The tank shall be of the capacity indicated and shall be designed for the pier support spacing shown. Tank construction shall conform to all applicable portions of the AWWA D-100 for design and construction. Tank shall be welded construction with a minimum shell thickness of 1/4 inch steel plate and 5/16 inch minimum flat heads.

12.2 Tank openings and pipe connections shall be of the size and located as shown on the drawings. Pipe connections 3 inches in diameter and less shall be welded steel Schedule 80 pipe couplings. Pipe connections and openings 4 inches in diameter and larger shall be fabricated of Schedule 40 steel pipe with 150 pound ANSI steel flanges. All openings 8 inches or larger shall be reinforced with 1/4 inch thick steel plate.

12.3 Inside of the storage tank shall be thoroughly cleaned by sandblasting (SSPC-SP5) and shall be coated with two coats of an approved epoxy polyamide system meeting Environmental Protection Agency requirements having a total dry film thickness of 6 mils. The exterior of the tank shall be sand blasted clean and painted with a shop coat of zinc chromate primer. The exterior shall receive two full coats of exterior enamel paint. Painting shall be performed after the tank is set in final position and all connections have been completed.

12.4 Disinfection of the water storage tank shall be in accordance with AWWA D102 except that the Contractor may spray or brush a 200 part per million solution of chlorine on the insides of the tank or fill the tank with a 50 part per million solution which shall be allowed to stand for 24 hours.

13. ELECTRICAL MOTORS AND CONTROLLERS: Shall be furnished with their respective pieces of equipment; and shall conform to and shall have all electrical connections provided under Section entitled Interior Electrical Systems; and shall be provided with maximum of 120 volt control holding circuits. The cost of providing additional electrical service and related work shall be included under this section when motors and equipment furnished are larger than sizes indicated.

14. INSTALLATION: Shall be in accordance with the Standard Plumbing Code.

14.1 Cleaning and Protection of Piping: Before being placed in position, pipe and fittings shall be cleaned carefully. Piping shall be maintained in a clean condition. All buried steel piping in corrosive soil or fill material shall be protected against external corrosion by coating with coal-tar enamel protective coating (AWWA C203).

14.2 Domestic Water Piping: Shall not be placed in the same trench as sanitary or storm drainage piping. Excavation and backfilling of trenches shall be as specified in Section entitled Earthwork.

14.3 Hub and Spigot Piping: Shall be laid with hub ends pointing up grade. Pipe shall be graded carefully and shall be supported firmly and uniformly at its proper elevation and grade. Adjacent lengths of pipe shall be adjusted with reference to each other; blocking or wedging between hub and spigot will not be permitted. Spigots shall be adjusted in hubs so as to give a uniform space all around. Open ends of pipe shall be closed by a watertight plug at the end of each day's work.

14.4 Types of Joints:

14.4.1 Calked Joints: Hub and spigot joints in cast iron pipe shall be firmly packed with oakum or hemp, and filled with one pouring of molten lead not less than one inch deep and not to extend more than one eight inch below the rim of the hub.

14.4.2 Rubber Gasket Joints: Insert gasket (ASTM C564) in the hub. Lubricate inside of gasket and push spigot end of pipe into the gasket until seated.

14.4.3 Mechanical Joints for Cast Iron Piping: Shall be installed in accordance with AWWA C600 and shall be anchored in accordance with NFPA 24. Sixteenth and sharper bends, tees and dead ends of pipe shall be securely blocked in the direction of flow with poured-in-place concrete bearing solidly against the pipe.

14.4.4 Soldered Joints: Clean and brighten the outside surface of the ends of the copper tubing which will fit into the fittings, and the inside of the fittings with steel wool or fine emery cloth. Apply a thin coat of noncorrosive flux or soldering paste on the cleaned portions of both tubing and fittings. Insert tubing to the full depth of the fitting, then solder with 50-50 lead-tin solder.

14.4.5 Union Type Connections or Unions: Shall be provided at piping connections to all fixtures and equipment.

14.5 Water Systems: Install with piping sloped towards the main shut-off valve or lowest fixture.

14.6 Water Valves: Install in accessible places with hose bibb on the building side of the main shut-off valve. Provide shut-off valve in each water supply to each fixture no provided with stop valves.

14.7 Sanitary Systems: Horizontal piping shall be installed at uniform slopes of eighth inch per foot for pipe sizes 3 inches and larger, and quarter inch per foot for pipe sizes less than 3 inches. Changes in direction of piping shall be made by the appropriate

use of 45 degree wyes, quarter, sixth, eighth, or sixteenth bends, or by a combination of these or equivalent fittings. Provide separate P-trap with cleanout for each fixture and drain which does not have integral trap. Vent stacks shall be extended to not less than 12 inches above the roof and shall be secured in vertical position.

14.8 Fixtures: Install fixtures level and in proper alignment with reference to adjacent walls to afford easy access for cleaning each fixture and the area about it. Floor outlet fixtures shall have connection between fixture outlet and floor flange sealed with rubber or was ring, and shall be secured to floor flange with bolts. Roll of fixture setting putty shall be applied to bottom rim of fixture in order to form a water tight joint between the fixture and floor. Exposed heads of bolts and nuts shall be chromium plated hexagons with round tops. Bolts and screws shall be 0.25 inch diameter and of sufficient length with hexagon heads. Through bolts shall have 0.125 inch steel plates, 6 inches wide by not less than 24 inches long, at the back side of the wall with washers and nuts. Fixtures and appurtenances shall be secured as follows:

14.8.1 Solid Concrete and Brickwork: Expansion bolts of a length sufficient to extend not less than 3 inches into concrete or brickwork.

14.8.2 Terra Cotta: Toggle or through bolts.

14.8.3 Wood: Hexagon head wood screws.

14.9 Pipe Sleeves: Provide where piping passes through masonry or concrete walls, floors, roofs and partitions. Sleeves shall be placed during construction. Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be standard weight zinc coated steel pipe. Sleeves in partitions shall be zinc coated sheet steel having a nominal weight of not less than 0.9 pound per square foot. Space between pipe or insulation, and the sleeve shall be not less than 0.25 inch. Sleeves shall be held securely in proper position and location during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Space between the pipe and the sleeve shall be firmly packed with insulation and calked at both ends of the sleeve with plastic waterproof cement. Sleeves are not required in floor slabs located on grade.

14.10 Pipe Hangers and Supports: Piping shall be installed without undue strains or stresses on fixtures and equipment. Piping provisions shall be made for expansion, contraction and structural settlement. Hangers and supports shall be securely attached to the building construction to support the piping, valves and its contents. Concentrated loads in piping between hangers and supports, such as inline pumps and flanged valves shall be properly supported.

14.10.1 Insulated Piping: Piping to receive insulation shall be provided with temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under another section of this specification.

14.10.2 Maximum spacing Between Hangers and Supports:

a. Vertical piping: Metal piping shall be supported at not more than ten foot intervals.

b. Horizontal Piping: Cast iron piping shall be supported at five foot intervals, except for pipe exceeding five foot length, supports shall be placed at intervals equal to the pipe length but not exceeding ten feet. Copper tubing shall be supported as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	1 and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper	6	7	8	8	9	10	11	12	13	14

14.11 Access Panels: As required for convenient access to shut-off valves and control devices, shall be furnished under this section of the specifications and shall be located and sized to provide proper access. They shall be installed by the appropriate trade. Access panels shall be prefabricated steel units consisting of a preformed angle or channel frame with a hinged or snap-on cover with spring catch or turn-latch. The wide-leg or flange of the frame section shall be perforated, or may extend into expanded metal wings to provide a key for plaster. Frames shall be not less than No. 16 US gage steel. Covers shall be not less than No. 14 US gage steel. Panels shall be factory primed with rust inhibitive paint.

14.12 Identification Plates and Tags: Equipment, gages, thermometers, valves and controllers shall be provided with 3 by 5 inch plates or tags numbered and stamped for their usage. Plates and tags shall be of brass or suitable nonferrous material and shall be securely mounted or attached. Plates and tags shall show the following information:

- a. Manufacturer, Type and Model Number.
- b. Contract Number and Accepted Date.
- c. Capacity or Size.

d. System in Which Installed.

e. System Which it Controls.

14.13 Disinfection: New water piping (and existing water piping affected by Contractor's operations) shall be disinfected as specified in Section "Water Distribution".

15. FIELD TESTING: Before final acceptance of the work, each system shall be tested as in service to demonstrate conformance with the contract requirements. The following tests shall be performed in addition to the tests specified in the Standard Plumbing Code. All defects in the work provided by the Contractor shall be corrected by him at his own expense, and the tests repeated until all work is in accordance with contract requirements. Contractor shall furnish water, electricity, instruments, connecting devices and personnel for the tests.

15.1 Domestic Water Piping: Hot and cold water piping shall be subjected to a hydrostatic pressure test of 100 psig for two hours.

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SECTION 15450. PIPING AND VALVES

1. APPLICABLE PUBLICATIONS: the following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal and Military Specifications:

WW-H-171E(1)	Hanger and supports, pipe.
WW-P-421C	Pipe, cast gray and ductile iron, pressure (for water and other liquids).
WW-U-531D	Union pipe steel.
WW-V-51F	Valve, angle, check and globe, bronze (125, 150 and 200 pound, threaded ends, flange ends, solder ends, and brazed ends, for land use).
WW-V-54D(3)	Valve, gate, bronze (125, 150 and 200 pound; threaded ends, flange ends, solder end, and brazed ends. for land use).
WW-V-58B	Valves, gate, cast iron; threaded and flanged (for land use).
MIL-C-27487	Quick disconnect couplings.
MIL-V-18436D	Valves, check, bronze, cast iron and steel body.
MIL-V-22133C(2)	Butterfly valves.

1.2 American National Standards Institute (ANSI):

A21.1-72	Thickness design of cast iron pipe.
A21.10-1971	Gray iron and ductile iron fittings, two inch through 48 inch, for water and other liquids.
A21.11-1972	Rubber gasket joints for cast iron and ductile iron pressure pipe and fittings.
A21.4-1971	Cement mortar lining for cast iron and ductile iron pipe and fittings for water.
B16.1-1975	Cast iron pipe flanges and flanged fittings, 25, 125, 250 and 800 pound.
B16.3-1978	Malleable iron screwed fittings, 150 and 300 pound.
B16.5-1973	Steel pipe flanges and flanged fittings including supplements.

1.3 American Society for Testing and Materials (ASTM):

A36-75	Structural Steel.
A53-78	Welded and seamless steel pipe.
A120-77	Black and hot-dipped zinc coated (Galvanized welded and seamless steel) pipe for ordinary uses.
A121-73	Zinc (Hot-Galvanized) Coating on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.

A320-74 Alloy steel bolting materials for low temperature service.
B211-66a Naval brass rod, bar and shapes.
B62-74 Composition bronze or ounce metal castings.
B88-76 Seamless Copper Water Tube.
B584-73 Copper alloy sand castings for general applications.

1.4 American Water Works Association (AWWA):

C110-71 Gray-iron and ductile-iron fittings, two inch through 48-inch, for water and other liquids.
C111-72 Rubber gasket joints for cast-iron and ductile-iron pressure pipe and fittings.
C500-71 Gate valves three inch through 48 inch, for water and other liquids.
C600-64 Installation of cast-iron water mains.

1.5 Manufacturers Standardization Society of the Valve and Fitting Industry:

SP 58-75 Pipe Hangers and Supports Design.
SP 69-76 Pipe Hangers and Supports Selected Applications.

1.6 Underwriters' Laboratories, Inc. (UL):

UL262-73 Gate valves for fire protection service (1970).
UL-789 Indicator posts for fire protection service (Jan 75).

1.7 LANTDIV Plates

WD-1 Standard thrustblocks for water lines.

2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" with the following additions and modifications, applies. The work includes providing all process piping and valving required for each system indicated. Each system shall be complete and ready for operation. Equipment, materials, installation and workmanship shall be in accordance with ANSI B16.1, B16.3, B16.5, B31.3 and all applicable manufacturer's instructions for specialty items.

3. SUBMITTALS REQUIRED: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists.

3.1 Manufacturer's Data:

- a. Flexible pipe couplings
- b. Gate valves
- c. Check valves
- d. Butterfly valves and actuators
- e. Pipe supports

- f. Sluice gates and actuators
- g. PVC flexible couplings

3.2 Certificates: Submit certificates from the manufacturer attesting that each of the following items conform to all requirements of this specification and of reference publications.

- a. Cast iron or ductile iron pipe
- b. Cast iron pipe fittings
- c. Steel pipe
- d. Butt weld fittings & flanges

4. MATERIALS:

4.1 Piping

4.1.1 Buried gravity piping shall conform to the requirements of Section "Storm Drainage Systems" unless indicated or specified otherwise.

4.1.2 Underground force mains and other pressure piping shall conform to the requirements of water piping for Section "Water Distribution" unless indicated or specified otherwise.

4.1.3 Above ground force mains and pressure lines three inches and larger, unless indicated or specified otherwise, shall conform to WW-P-421, working pressure 150 psi, cement lined and outside primed for painting. Pipe shall be thickness Class 22 for cast iron pipe and thickness Class 52 for cast ductile iron pipe. Flanges shall be faced and drilled conforming to ANSI B16.1, Class 125.

(a) Fittings. Cast iron flanged fittings shall be cement lined and shall be faced and drilled to conform to ANSI A21.10, Class 125.

(b) Flanged joints shall be in accordance with the recommendations of the pipe manufacturer. Drilling, bolts, and gaskets shall be standard for the flange.

4.1.4 All boiler blowdown piping shall be mechanical joint ductile iron pipe conforming to WW-P-421 except gaskets for mechanical joints shall be asbestos impregnated rubber suitable for hot water and steam services not to exceed 450°F.

4.1.5 All waste oil gravity piping and all piping smaller than three inches in diameter shall be standard weight zinc-coated steel pipe conforming to ASTM A-53 or ASTM A-120 unless indicated or specified otherwise.

(a) Fittings. Fittings shall be screwed, zinc-coated steel fittings conforming to ANSI B16.3.

(b) Unions shall be zinc-coated steel unions conforming to WW-U-531. Classes shall be suitable for intended working pressures. Dielectric connections shall be provided at all connections between ferrous piping metals. Unions shall be provided at piping connections to each piece of equipment.

4.1.6 Fuel distribution piping at the fuel farms for Sites IX-E and MCAS-A and all other miscellaneous fuel piping shall conform to Section "Fuel Distribution Systems" unless indicated or specified otherwise.

4.1.7 Pneumatic tubing for control system shall be copper tubing. Minimum tubing size shall be 5/16 inch. Copper tubing shall be hard drawn Type L conforming to ASTM B88 with soldered joints.

4.1.8 PVC flexible couplings for joining pipes of different materials shall be molded external fitted, pipe coupling. The material shall be virgin polyvinyl chloride compound with silica type filler, phthalate type plasticizers, and stabilizer for heat degradation, fireproofness, stability against light, ultraviolet or sunlight damage, mildew, and fungicidal resistance.

The coupling shall be selected to fit the appropriate pipe size and shall have a minimum flexibility of plus or minus 5 percent of the inside diameter of the coupling. The coupling shall be held firmly in place by adjustable stainless steel bands held within a depression in the coupling external surface. The band adjustment shall be taken up by a stainless steel screw contained within a stainless steel housing attached to one end of the band. The band shall be slotted to fit the adjustment device and sufficient length to permit full lightening of the coupling around the pipe being joined.

4.2 Valves

4.2.1 Gate valves on buried piping: Valves shall have non-rising stems and shall be double-disc parallel seat type. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit the easy removal of parts for repairs.

(a) Valves three-inch size and larger: Except as otherwise specified hereinafter, valves shall conform to AWWA C500. Valves shall have mechanical-joint or push-on joint ends and gaskets conforming to ANSI A21.11 (AWWA C111). Where indicated, valves shall conform to Standard UL 262 for use with post indicator. AWWA gate valves 16 inch size and larger shall be provided with gearing and by passes, and with post indicators.

(b) Valves smaller than three inch size: Valves shall conform to the requirements of AWWA C500, except for size. Valves shall be designed for a working pressure of 175 pounds per square inch.

4.2.2 Gate valves in valve chambers, valve pits and in above ground locations:

(a) Valves three inch size and larger: Valves shall conform to AWWA C500. Valves shall be of the outside-screw-and-yoke configuration. Valves shall have flanged ends unless otherwise indicated or otherwise specified hereinafter. In lieu of flanged ends, valves may have ends suitable for use with clamp-type mechanical couplings, provided that the valve ends conform to the applicable requirements specified hereinafter for this type of coupling. Valves conforming to WW-V-58 shall be Type II, Class 1.

(b) Valves smaller than three inch size: Valves shall conform to either WW-V-54 or WW-V-58. Valves conforming to WW-V-54 shall be Type III, Class A. Valves conforming to WW-V-58 shall be Type II, Class 1. Valves shall have threaded ends.

4.2.3 Check valves:

(a) Check valves three inch size and larger: Valves shall conform to MIL-V-18436. Valves shall have hub ends suitable for mechanical joint on buried lines; and shall have flanged ends in valve chambers, valve pits, or in above ground locations. Swing-check valves shall have clear-port opening. Valves conforming to MIL-V-18436 shall be Type III, shall have cast-iron or steel bodies with bronze trim, and shall be designed for a hydraulic working pressure of 175 pounds per square inch for valve sizes 12-inch and smaller and 150 pounds per square inch for valve sizes larger than 12 inch.

(b) Check valves smaller than three inch size: Valves shall conform to either WW-V-51 or MIL-V-18436. Valves shall have threaded or flanged ends as required to be compatible with the piping system in which the valve is located. Valves conforming to WW-V-51, shall be Type IV, Class A. Valves conforming to MIL-V-18436, shall be Type III, shall have cast-iron or steel bodies with bronze trim, and shall be designed for a hydraulic working pressure of 175 pounds per square inch.

4.2.4 Butterfly valves: Butterfly valves shall conform to MIL-V-22133, Type I, Class A, Series 200 except as modified hereinafter. Valves shall have cast or malleable iron body, aluminum bronze disc, Type 316 stainless steel stem, Buna-N rubber seat, and self-lubricating or acetyl bushings. The valve inner body shall be covered by a continuous replaceable seat of resilient, metal reinforced rubber to serve as a gasket between the valve and flanges and shall prevent the line fluid from contacting the valve stem or body. Valves shall be capable of closing against 200 pounds per square inch operating pressure.

(a) Butterfly valves six inches and smaller shall have a 10-position locking handle except where special actuators are required.

(b) Butterfly valves eight inches and larger shall have worm gear operators mounted directly to the valve. Gear operators shall be totally enclosed, permanently lubricated, weatherproof construction, hand wheel operated, with a valve position indicator to show disc orientation to the line except where special actuators are required.

(c) Electric motor actuators shall be weatherproof and watertight, suitable for 120 volt, single phase power and shall provide a torque at least 1.5 times that required to operate the valve. Reversing controllers overload relays and a space heater in the limit switch compartment shall be provided. All gearing in direct association with the electric motor drive shall be totally enclosed and operate in a lubricant. Provide all internal wiring connected to terminal strips for connection to external power, control and indicator circuits. Actuators shall be controlled by a remote automatic control and manual pushbutton operation with remote indicating lights to show the open or closed position of the valve. Actuators shall be capable of being automatically operated by an electrical signal from a float switch remotely located through a control panel specified in the section entitled "Controls and Alarms". Actuator shall include limit switches to provide indication of valve position by illuminating remote pilot lights. All limit switches shall be UL approved. Actuator shall be provided with manual override handwheel operator to open or close the valve during power failure.

4.2.5 Sluice Gates. Sluice gates shall be of the sizes shown and provided where indicated. Gates shall be designed to withstand unseating heads of 10 feet of water and seating heads of 20 feet of water.

(a) Sluice gate seats shall be one piece casting with a flat back and flange for attaching to the wall thimble. Gate shall be cast iron conforming to ASTM A126, Class B. The cast gate shall include all drilling bases, and guide support connections required for the proper operation of the gate.

(b) The gate slide or disk shall be of one piece construction, rectangular in shape with integral cast vertical and horizontal ribs. A heavy reinforcing rib along each side shall be provided to insure rigidity between side wedges. The slide shall be designed to operate under maximum specified unbalanced head with the minimum safety factor of six. Tongues shall be cast along each side of the slide and shall be machined all over.

(c) Frame. The frame shall be of the flanged type with square opening and shall have the back face machined for attaching to the wall thimble. The front face shall be machined for attaching of cast iron type guides or shall be provided with integrally cast guides to form grooves for slide tongues.

(d) Guides. Guides shall be of cast iron of the integral type as outlined above or shall be of the separate bolt on type attached with corrosion resistant fasteners. The later type shall be dowelled to prevent lateral movement with respect to the frame. Guide grooves shall be machined on all contact faces. Overall clearances with the slide tongue shall be not more than 1/16" on gate sizes 48" and smaller and 1/8" for larger sizes. Faces for mounting of wedging devices shall be fully machined.

(e) Seating Faces. Corrosion resistant metal seating faces shall be mounted around the perimeter of the slide and frame. Seating faces shall be bronze conforming to ASTM B21, alloy 482. They shall be mounted in dovetail slots and held in position without use of screws or other fasteners. After mounting they shall be machined to a plane with a 63 micro-inch finish or better. When the slide is in the fully closed position and wedged in position against the frame, maximum clearance between seating faces shall not exceed .004".

(f) Wedges. Each gate shall be provided with a sufficient number of wedging devices to provide a practical degree of watertightness. Side wedging devices shall be designed to make full metal to metal contact with the overhung portion of the wedge mounted on the guide, shall be fully adjustable and keyed to prevent rotation during gate closure. Side wedge shall be attached to the slide to lock it securely in position after it has been adjusted.

(g) Flush bottom seal. Gates so designated in the plans shall be provided with a slide or frame mounted flush bottom seal. The solid bulb resilient rubber seal shall be firmly held in place using cast iron retainers and corrosion resistant fasteners. The full length of the bottom edge of the slide shall be machined for mounting of the seal or for making uniform contact with the seal when it is mounted on the frame. The differential pressure on the rubber seal shall be variable by adjustment of wedges on the gate.

(h) Wall thimbles. Wall thimbles shall be heavy one piece iron casting of the type and length shown on the drawings. A center ring or water stop shall be cast around the periphery of the thimble. The front face of the thimble shall be machined and holes drilled and tapped for attaching of the gate with corrosion resistant metal studs. The vertical centerline shall be clearly marked at top and bottom to permit alignment of the front face in the vertical plane. Wall thimbles shall be internally braced during concrete placement to prevent warpage.

(i) Stems shall be threaded steel rods and shall have a minimum diameter 7/8 inch for gates 8 inch through 16 inch diameter, 1-1/8 inch for gates 18 inch through 24 inch diameter, and 1-1/2 inch for gates 30 inch through 36 inch diameter. Stems shall withstand the axial compressive and tensile forces created during gate operation under the specified unbalanced heads and to transmit in compression at least

two times the rated output of the lift with a 25 pound effort on the crank or handwheel. Threading on stems shall be machined cut or rolled with single or double lead threads of the Acme type. The contact surfaces of the threads shall have a minimum 63 micro-inch finish. Stem couplings shall have internal threads for transmitting the full thrust of the stem and shall be held in place on the stem by bolts or by keys in key-ways.

(j) Stem guides. Stem guides shall be fully adjustable, heavy-duty castings with bronze bushed removable cast iron collars. They shall be properly spaced to support the stem as a long column, but maximum spacing shall not exceed $1/r$ of 200.

(k) Manual lifts. The manual operated lifting mechanisms shall be of the handwheel or enclosed geared type as shown on the drawings. The handwheel type shall be without gear reduction. The crank operated type shall have either a single or double gear reduction depending upon the lifting capacity required. Each type shall be furnished with a threaded bronze lift nut to engage the threaded portion of the stem. The lift nut shall be flanged and supported on ball or roller bearings to take the thrust developed during opening and closing of the gate. The lift nut shall be bronze alloy conforming to ASTM B584, Alloy 865.

Gears, where required, shall be steel or cast iron with machine cut teeth designed for smooth operation. The gearings and lift nut shall be mounted in a cast iron housing which in turn shall be supported by a cast iron pedestal as indicated to place the input shaft or handwheel approximately 36" above the floor. Lubrication fittings shall be provided in the gear housing to permit lubrication of all gears and bearings. The removable cast iron crank arm shall be furnished with a revolving brass grip. An arrow shall be cast on the gear housing or handwheel to indicate the direction of the opening. A maximum effort of 25 pounds shall be required to operate the gate after it is unseated from its wedging devices. A lubricator flange shall be provided between the top of the pedestal and the gear housing to apply grease to the threaded portion of the stem.

All rising stem gates shall be supplied with a standard weight galvanized steel stem cover. All lifts shall be furnished with a cast iron stop nut.

(l) Electrically operated lift. The motor operated lift mechanisms required for the Backwash Waste Settling Tank at Site VII-9 shall include the electric motor reduction gearing, stem nut, pedestal, torque and limit switches, reversing magnetic starter, pushbutton control, indicator lights, shop wiring, gear cast, and handwheel for operation in case of power failure. The electrically operated lift shall be automatically controlled by a timer or pushbutton station as indicated and as specified in section "Controls and Alarms".

(1) Gear case. The gear case shall be made of cast iron. Integrally cast flanges for motor attachment, pedestal attachment, and an electrical control cabinet shall be fully machined and template drilled.

(2) Pedestal. Pedestals shall be fabricated steel or of cast iron with sufficient section to withstand the full load.

(3) Gears. The reduction gearing shall consist of helical gears, spur gears, and/or worm gears of the proper ratio to transfer the full torque of the motor to the stem nut.

(4) Bearings. Roller thrust bearings shall be provided on the stem nut to take the thrust developed during opening and closing of the gate under full unbalanced head.

(5) Stem nut. Stem nut shall be of high tensile bronze. The stem nut shall be of two-piece construction.

(6) Rate of Operation. All parts of the lifting operator shall be designed to move the gate slide at a rate of 10-12 inches per minute under the full specified unbalanced operating head.

(7) Electric Motor. Motors shall be of high torque, totally enclosed, non-ventilating construction. They shall be wired for the specified current characteristics. Motors shall be capable of running torque equal to 40 percent of the maximum required motor torque without exceeding the permissible temperature rise of 75° over a 40° C ambient.

(8) Torque Protection. The operating unit shall be equipped with an adjustable torque or thrust limiting switches capable of de-energizing the motor when the gate has reached the stops in the open or closed position or when an obstruction has been encountered.

(9) Limit Switches. Geared limit switches shall be of the adjustable type capable of being set to trip at the full open and full closed or any point between full or open closed gate position.

(10) Lubrication. All gearing and bearings shall be grease or oil lubricated to permit year-round operation in a range of temperatures from minus 20° Fahrenheit through 140° Fahrenheit.

(11) Operating Unit. The operating unit shall be equipped with a handwheel for emergency or manual operation.

(12) Electrical Enclosure. All controls shall be mounted in an enclosure integrally cast as a part of the gear case. It shall be provided with a hinged cast iron cover.

Three push buttons and two indicator lights shall be furnished in the electrical enclosure at the valve position. Push buttons shall be marked "open", "stop" and "close." A green indicator light shall be mounted opposite the "open" pushbutton and a red indicator light shall be mounted opposite the "close" button. Similar pushbuttons and lights shall be mounted in a separate remote control panel as specified in the section entitled "Controls and Alarms". Functional requirements are indicated.

The electrical compartment shall be provided with space heaters.

(13) Stem Cover. Each rising stem unit shall be provided with a galvanized steel stem cover made of Schedule 40 galvanized pipe.

(14) Indicator. Each rising or non-rising stem unit shall be provided with a dial position indicator to show gate position.

(m) Painting. Exposed machined or bearing surfaces shall be coated with the manufacturer's standard water resistant rust preventive compound. The assembled valve and lift shall be shop painted in accordance with the manufacturer's standard practice.

4.2.6 Post indicators. Post indicators for gate valves shall conform to UL 789. They shall receive at least one coat of primer and two coats of red enamel paint.

4.2.7 Valve boxes. Except where indicator posts are provided, each gate valve on buried piping shall be provided with a valve box as specified in Section "Water Distribution".

4.3 Flexible Couplings. Flexible couplings shall be installed on all lines entering tanks or buildings and on pump discharge lines. Couplings shall be solid sleeve type designed to absorb vibration and pipe movement for cast iron or steel pipe. The middle ring shall be of steel construction designed for a maximum working pressure of 700 pounds per square inch. Coupling shall be assembled with rubber gaskets suitable for salt water and oil service securely sealed to the middle ring and pipe outside diameter by steel follower rings bolted in place with properly sized steel bolts of sufficient length and number to assure uniform compression of the rubber gasket. Pipe ends shall be suitable for connection and shall be installed in each coupling according to the manufacturer's instructions.

4.4 Wall sleeves and wall pipes shall be cast iron as shown on the drawings unless indicated or specified otherwise.

4.5 Quick disconnect couplings shall be provided as indicated for the respective pipes. Coupling shall conform to MIL-C-27486. Coupling shall consist of bronze female adapter and bronze male adapter coupling with cap and chain. Coupling shall be suitable for threaded hose connection from fuel unloading trucks.

4.6 Swivel Joints. Low pressure swivel joints shall be provided for all swing arm funnel piping serving waste oil tanks as indicated. Swivel joints shall be standard series, low pressure swivel joints with two rows of ball bearings in cut races to handle moment, thrust and radial loads. Joints shall be malleable iron with threaded end connections sized to fit swing arm funnel piping as indicated. A lubrication port for greasing the ball bearings shall be provided and a grease retainer ring shall keep the ball rail clean. Swivel joints shall allow complete rotation of 360°.

4.7 Flap Valves. Flap valves shall be iron body, bronze mounted with bronze hinge pin, flap ring and seat ring and set to swing open under direct pressure to release the liquid. Valve shall close tightly when the direct pressure is relieved. Back pressure shall serve to hold the valve tightly against its seat.

4.8 Backwater valve shall be cast iron horizontal type with bronze swing check valve and revolving disc and extension type cleanout. Revolving disc shall provide a self-cleaning action for the seat and disc face. Valve hinge shall be balanced to allow the valve to open freely under low heads and close instantly at end of discharge.

4.9 Pressure gauges shall be installed on the discharge of each pump. Pressure gauges shall conform to GG-C-76 with a pressure of 0-60 pounds per square inch unless indicated otherwise. Pump gauges shall have a 360 degree loop of copper tubing filled with oil. Gauge shall be housed in a phenolic case with a minimum four and one-half inch diameter dial. Each gauge shall be provided with a shut-off petcock at each pressure tap location.

5. INSTALLATION: Work in this section includes all piping, drains, vents and piping connections to mechanical equipment specified in the Mechanical Division of these specifications. Associated excavation and backfill shall be as specified in the section "Earthwork".

5.1 Handling: Piping, fittings and associated accessories shall be handled in such manner as to insure delivery to the pipe support or the trench in sound, undamaged condition. Special care shall be taken not to injure pipe coatings or linings. If coatings or linings of pipe or fitting are damaged, satisfactory repair shall be made at no extra cost to the Government. Pipe shall be carried to the trench or supported and not dragged. Coated pipe shall be handled at all times with wide non-abrasive slings or belts, or other equipment designed to prevent damage. All such equipment shall be kept in repair. The use of tongs, bare pinch-bars, chain slings, rope slings without canvas covers, composition belt slings with protruding rivets, pipe hooks without proper padding or any other handling equipment found to be injurious to the coating will not be permitted. All skids used to support coated pipe shall be padded. Walking on the coated pipe will not be permitted.

5.2 Manufacturer's recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installations. Installations of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

5.3 Pipe, fittings, valves and accessories will be carefully inspected before and after installation, and those found defective will be rejected. Pipe and fittings shall be free from burrs. Before being placed in positions, pipe, fittings, valves and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for handling sections of pipe into position. Under no circumstances shall pipe, fittings, valves or any other material be dropped or dumped into trenches. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing.

5.4 Buried pipe lines: Excavation, bedding and backfilling of pipe trenches shall be as specified in section entitled "Earthwork" except as modified herein. Pipe shall be laid flat on the bottom of trench without blocks. All buried lines shall be installed on pipe bedding as specified in the section entitled "Earthwork". The pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate projections below the bottom of the pipe. Anchors and supports shall be provided where necessary and where indicated on the project drawings for fastening work into place. Trench shall be kept free of water during pipe laying operations. Open ends of pipe at the end of each day's work shall be closed temporarily with waterproof night-caps. Pipe shall not be laid when the conditions of trench or weather are unsuitable.

5.4.1 Cast or ductile iron pipe shall be installed in accordance with AWWA C600 except as modified herein.

(a) Pipe joint shall be of the types specified hereinbefore. Except as otherwise specified, joint installation shall follow the printed instructions of the pipe manufacturer.

(b) Push-on and mechanical joints shall be made in accordance with the requirements of AWWA C600; mechanical joints shall, further follow the "Notes on Installation of Mechanical Joints" given in ANSI A21.11 (AWWA C111). Flanged joints shall be made up tight, care being taken to avoid undue strain on flanges, valves, fittings and accessories. Opposite bolts or studs shall be alternately taken up until all bolts

are completely and uniformly tight. Flange stud bolts shall extend fully through their nuts with excess projection of at least two threads equal on either side. A light lubricant shall be applied to all bolts and studs prior to tightening. All flanges shall be made up with gaskets between the flanges.

5.4.2 Concrete Pipe Joints: Rubber gasket and preformed plastic joint installation shall be in accordance with the printed recommendations of the manufacturer of the joint material. 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 installation of the pipe, and 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 the joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

5.4.3 Joints for asbestos-cement pipe shall be made with couplings and sealing rings. Joints between asbestos-cement pipe and cast-iron fittings shall be push-on joints or mechanical joints. Sealing rings as specified hereinbefore shall be used with push-on joints; gaskets for mechanical joint shall conform to ANSI A21.11 (AWWA C111).

5.4.4 Threaded fittings for steel pipe shall be in accordance with ANSI B16.3.

5.4.5 Pipe anchorage: Anchorage of buried pipe lines shall be by means of concrete thrust blocks (reaction backing) using concrete with a minimum compressive strength of 2000 pounds per square inch. All 1/16 and sharper bends, tees and dead ends of pipe shall be securely blocked in the direction of flow with poured-in-place concrete bearing solidly against the pipe and against an undisturbed vertical trench face. All anchors shall be in accordance with LANTDIV Plate WD-1 at the end of this section.

5.4.6 Pipe Sleeves shall be provided where piping and tubing pass through masonry or concrete walls, floors, and partitions. Sleeves shall be placed during construction. Sleeves shall be held securely in proper position and location during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Where required, space between the pipe or tubing and the sleeve shall be firmly packed with insulation and calked at both ends of the sleeve with plastic waterproof cement. For pipe sleeve located in waterproof masonry,

the space between the pipe and sleeve shall be firmly packed with insulation, and caulked on each end of the sleeve with a polysulfide calking compound. The completed insulation shall be completely watertight.

5.4.7 Setting Valves and Valve Boxes: Valves and valve boxes shall be set plumb, and centered, with valve boxes placed directly over the valves. Valve boxes shall, if possible, be located outside the area of the roads and streets. Earth fill shall be carefully tamped around the valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valves shall have the interior cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the valve shall be inspected in opened and closed positions to see that all parts are in working condition.

5.4.8 Setting Post Indicators: Post indicators shall be installed with operating nut three feet above grade.

6. PIPE HANGERS AND SUPPORTS:

6.1 Pipe Hangers and Supports: MSS SP-58 and SP-69, Type 1 or Type 6, of the adjustable type shall be provided, except as specified or indicated otherwise. Insulated piping shall have insulation protected shields Type 40. Bronze or copper-plated collars shall be provided on uninsulated copper piping. Support rods shall be steel. The finish of rods, hangers, and supports shall be zinc plated, except for uninsulated copper piping they shall be copper plated. Piping to receive insulation shall be provided with temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations; temporary wood spacers shall be of the same thickness as the insulation to be provided under another section of this specification. Maximum horizontal spacing between hangers and supports for other than PVC pipe shall be as follows.

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	1 and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17
Copper Pipe	6	7	8	8	9	10	11	12	13	14

7. CLEANING, PURGING AND TESTING:

7.1 Cleaning: The Contractor shall keep the interior and ends of all new piping and existing piping affected by the Contractor's operations thoroughly cleaned of all foreign matter and water before and after installation. Piping systems shall be kept clean during installation operations by means of plugs or other approved methods. When work is

not in progress, open ends of piping and fittings shall be securely closed so that no water or other foreign substance will enter the pipes or fittings. On completion of laying the pipelines, they shall be cleaned by flushing with fresh water which shall eventually be used for the hydrostatic test.

7.2 Purging: Purging shall continue until all air in the pipe line has been displaced. The purged air shall be vented to the atmosphere in accordance with safety procedures approved by the Contracting Officer.

7.3 Field Testing: Before final acceptance of the work, each system shall be tested as in service to demonstrate conformance with the contract requirements. The following tests shall be performed; all defects in the work provided by the Contractor shall be corrected by him at his own expense; and the tests repeated until all work is in accordance with contract requirements. Contractor shall furnish water, electricity, instruments, connecting devices and personnel for the tests.

7.3.1 General: The Contractor shall be required to submit a program to the Contracting Officer describing his proposed method and sequence for filling and testing the lines and shall schedule his work at the "tie-ins" so that no delay shall occur in the proposed program of line filling.

7.3.2 Testing Equipment: All equipment, relief valves and any other appliances or fittings needed for testing shall be supplied by the Contractor. The Contractor shall calibrate all pressure gauges and submit certificate of calibration to the Contracting Officer.

7.3.3 Test procedure: All pipe lines shall be hydrostatically tested and held for 2 hours without a loss of pressure.

(a) Test Pressures

Force Main (Buried) - 100 psig
Force Main (Above ground) - 100 psig

7.4 Leakage and Repair of Pipeline:

7.4.1 If, as a result of the hydrostatic test, there is indication of loss of liquid from the pipe line, the Contractor shall locate the leak or leaks and shall correct any defects in the pipe line. Costs of locating and repairing such defects shall be at the Contractor's expense.

7.4.2 After repairs and examination have been made hydrostatic test shall be repeated until a satisfactory result is obtained.

8. FIELD PAINTING:

8.1 All exposed above ground piping and piping exposed in tanks shall be painted in accordance with the section entitled "Field Painting".

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SECTION 15460. COMPRESSED AIR SYSTEMS

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal and Military Specifications:

CC-M-1807	Motors, alternating-current, fractional and integral horsepower (500 horsepower and smaller).
GG-G-76D	Gages, pressure and vacuum, dial indicating.
WW-V-51E(2)	Valves, bronze; angle, check and globe (125, 150 and 200 pound; screwed, flanged and solder).
WW-V-54D(1)	Valves, gage, bronze (125, 150 and 200 pound; screwed, flanged and solder).
MIL-V-18634A(1)	Valves: safety, relief and safety-relief.

1.2 American Society of Mechanical Engineers (ASME):

1977(78)(79)	Unfired pressure vessel code.
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1.3 American Society for Testing and Materials (ASTM):

A48-74	Gray iron castings
A53-78	Welded and seamless steel pipe.
A108-73	Cold finished carbon steel bars and shafting.
A120-77	Black and hot dipped zinc-coated (galvanized) welded and seamless steel pipe for ordinary uses.
A331-74	Cold finished alloy steel bars
A395-75	Ductile iron press contain castings.
A536-12	Ductile iron castings.
A668-77	Alloy steel forgings for general use.

1.4 American National Standards Institute (ANSI/USA):

B16.3-1977	Malleable iron screwed fittings, 150 and 300 pounds.
B31.1-77	Power Piping.

2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" with the following additions and modifications, applies. The work includes the compressed air system for the bubbler control panel at Site VII-9 including compressors, air receiver, piping, valves and components complete and ready for operation. Also included is the diffused air blower system for the backwash surge tank at Site II-1. Materials and workmanship shall be in accordance with ANSI B31.1 and ASME Code for Unfired Pressure Vessels, except as specified or indicated otherwise.

3. SUBMITTALS REQUIRED: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists.

3.1 Manufacturer's Data:

Pressure gauges
Air Compressor
Air Blowers
Filters
Motors
"V" Belt

3.2 Shop Drawings:

Air Compressor Receiver

3.3 Certificates:

Piping
Air Compressor Receiver (ASME Code)
Valves

4. COMPRESSED AIR SYSTEM FOR BUBBLER CONTROL PANEL AT SITE VII-9:
The compressed air system shall be provided to continuously monitor the liquid level in the backwash waste settling tank and shall initiate the sequence timer as specified in the Section "Controls and Alarms".

4.1 Compressed air system shall include two identical single stage, oil less, piston-type compressors, motors, a control system and a single 30-gallon capacity horizontal receiver tank assembled as a packaged unit.

4.1.1 Compressors shall have a piston displacement 2.86 cubic feet per minute at a maximum speed of 1725 revolutions per minute at a discharge pressure range of 35 to 50 pounds per square inch gage and shall be driven by a 1/2 horsepower electric motor operating on 460 volts, three phase, 60 Hertz, alternating current. Compressor shall have an intake filter and shall be controlled by an adjustable pressure switch.

4.1.2 Thirty-gallon steel air receiver tank shall be constructed according to ASME Code and rated for 100 pounds per square inch. Tank shall have inlet, outlet, drain, and air pressure gauge connections. Gate valves conforming to WW-V-54 shall be provided on the drain and outlet connections.

4.1.3 Compressors operation shall be automatically controlled by pressure switches to start the lead and standby compressors based on the pressure in the air receiver tank. The lead-standby compressor sequence will be set by an adjustable manual selector switch and elapse time meters shall be provided for each compressor motor for determining

compressor operating time. Compressor shall cut on at 80 pounds per square inch and cut off at 100 pounds per square inch.

4.1.4 The air receiver tank shall include a four and one-half inch dial pressure gauge that shall conform to GG-G-76 with a range of zero to 100 pounds per square inch. The air receiver tank shall have an ASME standard safety relief valve with a minimum capacity of five standard cubic feet per minute of air at a set pressure of 8 pounds per square inch gage.

4.1.5 The control panel for the compressors shall include magnetic starters, main disconnects, elapsed time meters, terminal blocks and wiring for the proper operation of compressors.

5. DIFFUSED AIR BLOWER SYSTEM FOR SITE II-1: A diffused air blower system shall be provided as indicated for the Backwash Surge Tank at Site II-1. The system shall include air diffusers, air piping, air blower, controls and accessory items as indicated and as specified herein.

5.1 Air Diffusion System: Diffusers shall be of the coarse bubbler, non-porous nozzle type. Nozzle devices shall be saddle-mounted or thread-mounted on a diffuser header as recommended by the diffuser manufacturer. Nozzle orifice shall be sized for the particular application to assure proper range of exit velocity and back pressure. Units shall be cast iron, plastic or stainless steel.

5.2 Air blower assembly: Air blower assembly shall include driver, speed reducer, base plate, pressure relief and unloading valve, check valve, silencer, expansion joints, gate valve, thermometer, pressure gauge, guards, and suitable weatherproof metal housing with controls.

5.2.1 Air blowers shall be the rotary positive displacement, single-stage centrifugal or multi-stage centrifugal type. Performance requirements for the blower shall be as follows:

Inlet Volume (SCFM)	119
Speed (RPM)	1300
Inlet pressure (PSIA)	14.7
Inlet Temperature (°F)	68
Relative Humidity (%)	36
Discharge Pressure (PSIG)	6
Motor HP (Min.)	5

The allowable tolerance on the stated inlet volume shall be plus or minus four percent. The units shall be equipped with heavy-duty antifriction bearings. Impellers, except when cast integrally with the shaft, shall be made of close-grained cast iron conforming to Class 35 of ASTM A48, or ductile iron conforming to ASTM A395 or A536, or welded alloy steel conforming to ASTM A331. Impellers shall have strong internal

ribbing, shall be machined on all exterior surfaces, and shall be dynamically balanced. Shafts shall be machined and, except when cast integrally with the impeller, shall be made of steel conforming to ASTM A108 or alloy steel forgings conforming to ASTM A668. When shaft and impeller are cast integrally, the casting shall be of ductile iron conforming to ASTM A536. When shaft and impeller are separate pieces, impeller shall be press fit onto the shaft and held by means of a Woodruff key and lock nut, or the impeller shall be mounted on the shaft with a reverse threaded connection. The casing shall be cast iron conforming to ASTM A48, Class 30. The rotary displacement type unit shall have two timing gears machined from heat-treated steel to accurately synchronize the impellers so as to maintain maximum rotation efficiency. Gears shall be enclosed in an oiltight housing and shall be lubricated by a splash oiling system from oil contained in the gear housing or pressure lubricated with integrally driven oil system. Blower shall be mounted in the horizontal position. Air discharge shall be to the bottom when viewed from the drive end. Blower shall be V-belt driven by the blower driver or be direct-connected to the gear reducer and blower driver. Blower shall be equipped with a Kingsbury type thrust bearing on the drive shaft so that no thrust from the driver will be transmitted to the blower impellers. The blower shall have an operating sound pressure level not to exceed 85 decibels over a frequency range of 37.5 to 9600 cycles per second measured at five feet from the unit. The manufacturer shall provide any silencing on the blower needed to meet this requirement.

(a) Bearings for positive displacement type blower shall have a minimum rated life expectancy (L-10) of 50,000 hours, and for centrifugal type blower, 30,000 hours, based on the Antifriction Bearing Manufacturers Standards. Internal bearings shall be splash lubricated from the gear housing oil reservoir. Drive-end bearings shall be grease lubricated through grease fittings in each bearing housing located so that they are easily accessible. Grease vents shall be provided in the bearing housing to prevent rupture of grease soils from overgreasing. Air vents shall be provided between the seals and the impeller chamber to relieve excessive pressure on the seals.

(b) Couplings shall be self-aligning forged steel gear type having two identical hubs, two identical sleeves, a flange gasket, a set of flange bolts, nuts, and lockwashers, and four lubrication plugs with copper gaskets. Torque shall be transmitted through the mating gear teeth of the hubs and sleeves.

5.2.2 Blower driver. Blower shall be driven by an electric motor through a gear reducer or V-belt drive at a speed corresponding to its peak efficiency. Motor shall be totally-enclosed, fan-cooled explosion-proof, Class 1, Group D, Division 2. If induction type, motors shall have NEMA Class B insulation, normal starting torque, low starting current. If synchronous, it shall operate on .80 power factor. Excitation shall be by direct-connected exciter. All frame sizes shall be NEMA

standards. The electric motors shall have an operating sound pressure level not to exceed 90 decibels over a frequency range of 37.5 to 9600 cycles per second measured at five feet from the unit. The manufacturer shall provide any silencing of the motor needed to meet this requirement.

5.2.3 Speed reducer shall be either V-belt drive or gear reducer.

(a) V-belt drive shall include blower sheave, motor sheave and V-belt. Sheaves shall be cast steel and keyed to the shaft. Multiple belts shall be used when necessary to transmit the required power. V-belt shall be of a heavy-duty type, oil and heat resistant, and static dissipating. Drive shall be designed to have a minimum service factor of 1.5.

(b) Gear reducer. The gear drive shall be designed to transmit the maximum continuous power capability of the driver with a 2.0 service factor. The thermal rating (manufacturer's catalog value) of the frame shall not be exceeded by the input horsepower, excluding the gear service factor. The pitch-line velocities shall be less than 20,000 feet per minute. Gear casing shall be of cast iron conforming to ASTM Specification A48 or fabricated steel type having center line split design and shall incorporate bolting flanges to mate with both input coupling guards. The gear unit shall incorporate double helical gears having hobbled and ground-finished teeth. Gear shafts shall be supported in sleeve-type bearings, and both input and output shafts shall terminate in a standard taper. Gears shall be lubricated by a splash oiling system from oil contaminated in the gear housing. The driver gear unit shall have an operating sound pressure level not to exceed 85 decibels over a frequency range of 37.5 to 9600 cycles per second measured at five feet from the unit. The manufacturer shall provide any silencing of the reducer needed to meet this requirement.

5.2.4 Base plate. A cast iron or welded steel base plate sized to carry the blower, speed reducer, and blower driver shall be provided with the necessary anchor lugs for foundation bolts. It shall have sufficient rigidity to maintain alignment between the various elements.

5.2.5 Pressure relief and unloading valve. A pressure relief and unloading valve shall be provided for the dual function of pressure relief and unloading the blower for start-up. The valve shall have a cast iron body with integral valve seat, cast iron disc, and steel spring for pressure setting. Valve shall be provided for a pressure setting of 15 pounds per square inch, but shall also have an operating nut or wheel for field adjustment of pressure setting. Pipe connection shall be flanged or screwed.

5.2.6 Weatherproof enclosure. Blower and motor assembly shall be enclosed and supported in a weatherproof enclosure. The enclosure shall be constructed of 16 gauge steel supported by the structural members to obtain rigidity. All parts shall be phosphatized and double coated with

a factory applied baked enamel finish. Enclosure shall be provided with necessary louvers for venting.

5.2.7 Controls for the blower shall include a 3 pole, 30 amp circuit breaker, size 1 magnetic starter and on-off push button station. Controls shall be mounted in the weatherproof housing for the blower.

6. COMPRESSED AIR PIPING (ALL SYSTEMS):

6.1 Piping shall be standard-weight zinc-coated steel pipe conforming to ASTM A53 or A120. All nipples in screwed piping shall be extra-strong.

6.2 Fittings shall be screwed zinc-coated steel fittings conforming to ANSI B16.3.

6.3 Unions shall be zinc-coated steel unions conforming to WW-U-531. Dielectric connections shall be provided at all connections between ferrous and nonferrous piping metals. Unions shall be provided at valves, and piping connections to each piece of equipment.

6.4 Bubbler piping shall be as specified in Section "Controls and Alarms".

6.5 Valves:

(a) Gate valves shall conform to WW-V-54, Class A.

(b) Check valves shall conform to WW-V-51, Class A.

(c) Relief valves shall conform to MIL-V-18634, Type III, Class 10, Style A, except as specified otherwise. Relief valves shall be suitable for compressed air service. Relief valves shall have discharge piped to safe location so that the discharge will not strike personnel. Relief valves shall bear the seal of approval of the ASME, and shall be set and stamped.

7. PRESSURE GAGES shall conform to GG-G-76, Class I, Style A, Type 1, except as specified or intended otherwise. Gages shall be provided with stainless steel tube, brass, case, non-shatterable safety glass and a pressure relief valve. Each gage shall be provided with a pulsation damper of a size and design suitable to dampen vibrations due to sudden pressure changes, a slow opening needle type gate valve, a branch with provisions for bleed-off. The bleed-off may be incorporated in the gage valve. Scale range shall be suitable for the intended service.

8. FLEXIBLE CONNECTORS FOR 100 POUNDS PER SQUARE INCH GAGE COMPRESSED AIR SYSTEMS shall be of corrugated bronze or stainless steel type with braided covers, suitable for the intended service, and designed for 125 pounds per square inch gage operating pressure.

9. HANGERS AND SUPPORTS shall be as specified in section entitled "Plumbing".

10. IDENTIFICATION TAGS AND PLATES: All equipment, gages, valves, and controllers shall be provided with tags numbered and stamped for their usage. Plates and tags shall be of brass or suitable nonferrous material and shall be securely mounted or attached.

11. INSTRUCTIONS: The Contractor shall furnish the services of qualified representative(s) regularly employed by the air compressor and blower manufacturers to instruct the Government personnel in the operation and maintenance of the air compressor and blower and related equipment. A representative shall be provided for each different manufacturer for a period of one eight hour working day when the unit is placed in operation. The manufacturer's representative(s) shall check the installation of the air compressor systems and accessories, and shall supervise the testing and adjustment of the air compressor and blower assemblies.

12. TOOLS: A complete set of special tools and wrenches necessary for the proper repair, maintenance and operation of the compressor, blower, equipment and systems shall be furnished to the Contracting Officer.

13. FIELD PAINTING of all pipe, pipe hanger and appurtenances is specified in the section entitled "Field Painting".

14. TESTS: Compressed air system, but not including compressor, blower, filter, and equipment which would be damaged by water, shall be subjected to hydrostatic tests as specified hereinafter before being placed in operation. The system shall then be flushed clean of all grease, dirt and lint, preferably with steam or hot water until no oil film is present in the water and then dried with air. After the satisfactory completion of the hydrostatic test and cleaning, the system shall be charged with air to a pressure equal to the design working pressure of the system. Each system shall then be examined, joints shall be soaped, and any leaks corrected. Compressed air at working pressure shall then be allowed to stand in each system to equalize the temperature. The pressure drop, corrected for temperature changes, shall be not over one percent in 24 hours. All defects shall be corrected and the system retested until proven satisfactory. Substitution of an air test in lieu of the hydrostatic test specified will not be allowed. All equipment shall be tested as in service to determine compliance with the contract requirements. During the test, all equipment shall be tested to demonstrate performance of their required function. All defects in the work provided by the Contractor shall be corrected by him at his own expense, and the test repeated without additional cost to the Government until proven satisfactory to the Contracting Officer. The system shall be completely tested for compliance with specification and

all conditions thereof, and all adjusting and balancing shall be completed to the satisfaction of the Contracting Officer.

14.1 Hydrostatic test pressure shall be 150 psig for the compressed air system.

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SECTION 15470. PUMPS

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal and Military Specifications:

CC-M-1807	Motors, alternating current, fractional and integral horsepower (500 HP and smaller).
MIL-P-23235(4)	Paint coating system, steel ship tank, fuel and salt water ballast.

1.2 American National Standards Institute (ANSI):

B16.1-1975	Cast iron flanges and fittings 25, 125, 250 and 800 pound.
B16.5-1977	Steel pipe flanges and flanged fittings.
B17.1-67	Keys and key seats.
B17.2-67	Woodruff keys and key seats.

1.3 American Society for Testing and Materials (ASTM):

A120-76	Black and hot dipped zinc-coated welded and seamless steel pipe for ordinary uses.
A216-75	Carbon steel castings suitable for fusion welding after high temperature service.
A278-74	Gray iron castings for pressure containing parts for temperatures to 650 degrees Fahrenheit.
A296-75	Corrosion resistant iron chromium, iron chromium nickel and nickel base alloy castings for general purpose.
A320-74	Alloy steel bolting materials for low temperature service.

1.4 American Gear Manufacturers Association (AGMA):

210.02	Surface durability (pitting) of spur gear teeth.
211.02	Surface durability (pitting) of helical and herringbone gear teeth.
211.02A	Rating for the durability of helical and herringbone gears for enclosed drives.
211.02B	Rating for the durability of helical and herringbone gears for gearmotors.
215.01	Information sheet for surface durability (pitting) of spur, helical, herringbone and bevel gear teeth.
220.02	Rating of strength of spur gear teeth.

221.02	Rating the strength of helical and herringbone gear teeth.
221.02A	Rating for the strength of helical and herringbone gears for enclosed drives.
221.02B	Rating for the strength of helical and herringbone gears for gearmotors.
225.01	Information sheet for strength of spur, helical, herringbone and bevel gear teeth.
226.01	Information sheet - geometry factors for determining the strength of spur, helical, herringbone and bevel gear teeth.
241.02	Specification for general industrial gear materials-steel (drawn, rolled and forged).
243.51	Specification for worm gear bronze.
245.01	Specification for cast steel gear materials.
390.03	Gear classification manual.
420.03	Practice for helical and herringbone gear speed reducers and increasers.
440.03	Practice for single and double-reduction cylindrical-worm and helical-worm speed reducers.

1.6 Steel Structures Paint Council (SSPC):

SSPC-SP6-63	Commercial blast cleaning.
SSPC-SP10-63T	Near-white blast cleaning.
SSPC-PS-10.02-64T	Coal tar coating system - No. 10.02 cold applied coal tar mastic.

2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" with the following additions and modifications, applies. The work includes all pumps for pumping filter backwash wastes, storm water runoff, sewage, sludge, water and backwash waste supernatant. Pumps of each specific type shall be of the same manufacturer to reduce spare parts inventory requirements. Pump construction shall be in accordance with the requirements specified hereinafter and all flanged connections shall conform to ANSI B16.1 or B16.5.

3. SUBMITTALS REQUIRED: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following:

All Pumps

3.1 Shop Drawings

- a. Pump Base Plates.
- b. Hinged access doors and frames.
- c. Pump rail guides and support systems.

3.2 Certificates: Submit certificates from the manufacturer attesting that each of the following items conform to all requirements of this specification and of reference publications.

a. Certified Performance Curves for All Pumps.

4. SUBMERSIBLE PUMPS

4.1 Submersible pumps shall be provided where indicated and in accordance with the pump schedule shown. All submersible pumps shall be provided with pump base plates and discharge elbows. Submersible pumps at the following sites shall also be provided with quick disconnect discharge flanges, pump rail guides, pump base plates with discharge elbow and rail supports, access frame with cover plates and guide rail supports, and pump lifting chains and hooks:

Site I - H	Site X - 1
Site I - 2	Site X - 2 (Grinder Pumps)
Site II - 1	Site XII - 1
Site VII- G	Site MCAS - E
Site VII- 4	Site MCAS - L
Site VII- 5	Site MCAS - 2
Site VII- 9	

4.1.1 To insure compatibility of equipment, all submersible pumps and accessories shall be the product of one source.

4.2 Submersible pumps shall be of the sealed submersible type capable of handling the liquids indicated on the pumps schedule. Pump shall be provided with two port non-clog type impellers. Impellers shall be cast iron or standard bronze in accordance with the pump manufacturer's standards. Where indicated on the pump schedule, pumps shall be provided with recessed impellers. Pump casing shall be fitted with bronze wear ring. Pump shall have two mechanical seals with oil chamber between the seals. Rotating seal faces shall be carbon and stationary seal faces to be ceramic. All metal parts of seal including spring shall be 303 Stainless steel. All pump fasteners shall be 303 Stainless steel.

Pump motor shall be of the sealed submersible type with standard insulation for operation in high-dielectric oil to give better heat dissipation and longer bearing life. Motor stator shall be held in place with removable end ring so that it can be removed for repair without heating outer shell or using a press. Motor housing shall be filled with high-dielectric oil and no pressure balancing devices shall be used. Pump motor shaft shall be of 303 Stainless steel.

4.2.1 Submersible spray pump for the Blowdown Cooling Tank at Site VII-G-2 shall be suitable for operation at temperatures up to 210°F.

4.2.2 Submersible sump pump located in the Sludge Pump Pit at Site VII-9 shall be controlled by a hermetically sealed mercury displacement switch with an external float. The switch shall be factory mounted to the pump and shall be sized for the starting amperage of the pump.

4.2.3 Where required, pumps shall be provided with attached guide rail system. Rail guards shall be fastened to the pump so that all lifting loads will come on the guide supports and not on the pump or motor housing. A lifting chain and hook shall be provided for each pump where guide rails are used.

4.3 Pump Base Plate. A separate base plate shall be provided for each pump. All base plates shall include discharge elbow supports. Where required, base plates shall include adjacent guide rail supports and discharge elbow with flange to align with pump hydraulic sealing flange. Plates and fittings shall be coated with tar base epoxy paint.

4.4 Quick Disconnect Discharge Flange. Hydraulic sealing flange shall be diaphragm type hydraulically operated. When pump is in operation, pressure shall force diaphragm against discharge elbow flange providing a leak-proof seal. When pump is idle, pressure shall be removed from diaphragm so that pump can be removed from sump with no mechanical contact of sealing flanges. Complete weight of pump to rest on bottom support plate. No weight to be supported on guiderails or discharge elbow. Sealing diaphragm shall be removable and mounted on pump discharge flange. Diaphragm material to be Buna N rubber.

4.5 Pump rail guides. Pump rail guides shall be manufacturer's standard, but in no case less than two inches in diameter, suitable for easy removal of pump. Intermediate guide rail support braces shall be provided where tanks, pits, etc. are more than 10 feet deep. Support braces shall be used to stiffen guide rails.

4.6 Access Frame and Cover. A double door access frame assembly shall be provided where required. Access frame and covers shall be fabricated of steel and shall be coated inside and outside with tar base Epoxy paint. Frame shall support guide rails. A separate hinged cover shall be provided for each pump. Cover shall be provided with lifting handle and safety latch to hold cover in the open position. Locking hasps shall be furnished for each cover.

5. GRINDER PUMPS

5.1 Dual submersible grinder pumps including pump mounting plates with bottom rail supports, hydraulic sealing flanges, pump rail guides, access frame with cover plates and guide rail supports, and pump lifting chains and hooks shall be provided at Site X-2. The operating conditions of the grinder pump shall be as indicated on the pump schedule.

5.2 Grinder pumps shall be designed to shred solids normally contained in domestic sewage to a slurry that can be pumped. The pump shall consist of radial and axial cutters and a cutter ring of hardened and ground stainless steel. Pump shaft, as well as outside fasteners, shall be stainless steel. Impeller and grinder assembly shall be on the same shaft and supported by permanently oil lubricated ball and sleeve bearings. Impeller shall be bronze or ductile iron cadmium plated.

Pump motor shall be of the sealed submersible type constructed for operation in high dielectric oil for cooling open winding and lubricating bearings. Motor shaft and housing shall be sealed with two mechanical shaft seals with an oil chamber between seals. Seals shall have carbon and ceramic seal faces.

5.3 Grinder pump accessory equipment, such as, guide rails, hydraulic sealing flanges, access frame and cover plate, etc. shall be as specified for the submersible pumps.

6. VERTICAL TURBINE PUMPS shall be single or multiple stage centrifugal pumps assembled in a complete unit to provide the flow rates at the specified total dynamic head, efficiency and shutoff head. Vertical turbine pumps shall be provided in the Recycle Pump Stations located at Sites III-1, XIII-1, and MCAS-4.

6.1 Pump discharge head shall be fabricated from steel conforming to ASTM A216, Grade WCA or WCB. The discharge flange shall conform to ANSI B16.5, Class 150. The unit shall be designed to support the entire pump assembly and electric drive motor as indicated or specified. The discharge head shall include a machined flange for direct mounting of properly sized NEMA flanged motor with large hand holes to permit motor coupling connection and stuffing box adjustment or repacking without removal of the motor. The discharge head shall include a shaft stuffing box and bearing at the base to assure shaft alignment through the stuffing box.

6.1.1 Stuffing box shall be designed to accept either packing or a mechanical seal. The stuffing box shall include a zinc-less bronze bearing (SAE 64), space for six rings of packing, lantern ring, and a split gland. Stuffing box shall be capable of 175 pounds per square inch pressures and shall have tapped inlet holes for the introduction of sealing fluid.

6.1.2 Base bearing shall be installed at mounting flange to provide proper alignment of the shaft through the stuffing box. The bearing shall be zinc-less bronze bearing (SAE 64) and retained in the assembly to assure proper alignment of the shaft throughout the entire pump length.

6.2 Pump column assembly shall include discharge column pipe of steel conforming to ASTM 120, Grade B. The column shall provide space for intermediate alignment and support bearings, line shaft, line shaft couplings, and bearing retainers. All bearings shall be zinc-less bronze conforming to SAE 64 and shall not exceed a spacing of 5 feet for shaft speeds of 1750 revolutions per minute or 3 feet for shaft speeds of 3500 revolutions per minute. The pipe column and wetted parts shall be coated as follows:

6.2.1 Preparation: Surfaces shall be dry sandblasted in accordance with SSPC-SP-10, Near White Blast Cleaning. Coating shall be applied to blasted surfaces as soon as possible. All blasted surfaces that become contaminated with rust, oil, grease, or other deleterious substances before coating shall be reblasted to remove such contaminants before coating. Wet sandblasting shall not be allowed. Solvents shall not be used for cleaning surfaces.

6.2.2 Application: Coating material shall be applied under dry and dust-free conditions. Steel shall be free from moisture and frost when painted. The temperatures of the metal shall not be less than 45 degrees Fahrenheit and not over 90 degrees Fahrenheit when coating material is applied. All coating material shall be deposited carefully and thoroughly by means of such spraying equipment as described in the printed instructions of the coating manufacturer. The coating shall be mixed in strict accordance with the manufacturer's printed instructions and shall be sprayed in an even, wet film, overlapping each pass 50 percent to avoid thin spots.

6.2.3 Coating: Surfaces shall be coated with spray-applied post cured inorganic zinc conforming to MIL-P-23236, Type I, Class 3, applied to a dry film thickness of 3.5 mils. In addition, inorganic zinc coating shall be given a top coat of coal tar epoxy conforming to MIL-P-23236, Type I, Class 2, applied to a dry film thickness of not less than 5 mils. Before application of epoxy top coat, inorganic zinc coating shall be given a tie coat in accordance with manufacturer's recommendations. Tie coat dry film thickness shall be one mil. Epoxy top coat application shall be as specified for inorganic zinc coating. Inorganic zinc coating, tie coat, and epoxy top coat shall be by same coating manufacturer.

6.2.4 Repairs to coating: All surfaces which have been damaged during shipment, erection or Contractor's operations shall be sandblasted and coated after erection has been completed.

6.2.5 The wetted steel and cast iron casing pump column shall receive coal tar base coating conforming to SSPC-PS-10.02 applied to a minimum dry film thickness of 30 mils.

6.3 Pump line shafting shall be fabricated of Type 316 stainless steel conforming to ASTM A296, Grade CF-8M. Pump shafting shall be oversized for horsepower required and for operation below half-critical speed. Shaft coupling shall be adjustable type with key ways and retainers.

6.3.1 All bolting shall be Type 316 stainless steel conforming to ASTM 320, Grade B 8M.

6.3.2 Sectional flanges shall have machined grooves for alignment and indexing.

6.4 Pump impellers shall be semi-open, zinc-less bronze conforming to SAE 64. The impellers shall be securely locked to the pump shaft with taper locked collet except where temperatures or larger sized impellers require keyed construction.

6.5 Bowl assembly shall include a suction bell and one or more intermediate bowls. The bowls shall be assembled by flanged construction and each bowl shall be cast iron conforming to ASTM 278, Class 30. The bowl flanges shall be machined and grooved to insure accurate alignment of all rotating parts at the factory and at subsequent maintenance disassembly repair and reassembly.

6.6 Suction strainer shall be provided on pumps. The strainer shall be securely attached to the pump suction bell and be standard construction normally provided with pump. Screens shall be Type 316 stainless steel and shall have a minimum opening of 1/4 inch square and maximum opening of 1/2 inch square.

6.7 Pump column lengths shall be verified by the Contractor to assure proper clearances from the tank bottoms as recommended by the pump manufacturer and consistent with the pump out level requirements for each tank. In addition, the support anchor bolts and openings shall be verified to assure the installation and subsequent removal of the pump from position without removing any portion of the pump housing or bowls.

6.8 Pump shall be lubricated in operation by grease lubricants recommended by the pump manufacturer.

7. SLUDGE PUMPS. Sludge pumps shall be a positive displacement progressive cavity type with single rotor and flexible rubber stator driven by a variable speed electric motor. Pump shall be capable of operating equally when driven in either direction of rotation. Sludge pumps shall be installed in the Sludge Pump Pit at Site VII-9.

7.1 Pump body shall be cast iron construction including feet for mounting, bearings for radial and thrust loads, and shaft stuffing box with a minimum of five rows of packing, lantern ring and packing gland.

The pump drive shaft shall be carbon steel and provide a connection for the pump rotor.

7.2 The stator shall be contained within a threaded steel enclosure for attachment to the pump body. The stator shall be Buna-N rubber for resistance to lime sludges.

7.3 The helical rotor shall be constructed of Type 316 stainless steel protected by a heavy layer of hard chrome plating.

7.4 Drive motor shall be a variable speed electric motor drive as specified hereinafter with a remote speed control adjustment. Connection between pump shaft and drive motor shall be a flexible rubber type coupling of the proper size to transmit the horsepower and torque required by the pump performance requirements. Variable speed drive shall have a speed variation range of 4 to 1 with a minimum output speed of 300 revolutions per minute.

7.5 Pump and motor shall be mounted on a fabricated steel base which will accommodate the electric motor and pump assembly and provide anchoring lugs for securing the pump assembly in pumping position.

8. The Pressurization Pump provided at Site VIII-1 shall be as specified in Seccion: "Plumbing".

9. PUMP ELECTRICAL DRIVES. Each pump specified for electrical drives shall conform to CC-M-1807 and shall be horizontal or vertical type required for specific pump application. All motors shall have a service factor of 1.15.

9.1 Motors for the Vertical Turbine Pumps shall be squirrel cage motors, totally enclosed fan cooled construction and shall operate at a maximum temperature rise of 50 degrees centigrade.

9.2 Mechanical variable speed drive units for the sludge pumps shall be complete assembled units containing a flange mounted single speed electric drive motor, variable pitch sheaves, and an output gear reducer to provide the speed range and horsepower required for the specific pump application.

9.2.1 The mechanical variable speed drive shall have a minimum speed range of 4 to 1 and shall be manually or remotely adjustable in infinite steps over the entire speed range. The drive shall be designed for continuous operation with a minimum service factor of 1.5. All bearings shall be of the anti-friction ball or roller type, having an Anti-Friction Bearing Manufacturers Association minimum rated life (L10) of 50,000 hours. Bearings shall be grease lubricated.

9.2.2 Variable speed discs shall be of the non-lubricated type. The transmission shall be designed so that the mid-point of the speed

range would represent approximately a 1 to 1 ratio in the belt transmission.

9.2.3 Driving belts shall be of heavy duty glass cored rubber, pressure molded, rubber edge type or steel link belt having a minimum life of two years. One spare driving belt shall be supplied with each mechanical adjustable speed drive unit.

9.2.4 Gear reduction portion shall be designed with a minimum AGMA service factor of 1.5 with the unit operating at full motor horsepower, 24 hours a day continuous running under moderate shock loads. It shall have a life expectancy of 100,000 hours. The unit shall be designed to withstand any loadings produced by thrust, out of balance, and vibration resulting from operating conditions. All components shall be designed to withstand continuously the full motor load horsepower for the life expectancy specified, including motor starting torques up to 250 percent of motor running torques. Gearing may be spur, helical spiral worm or a combination thereof. If helical, the helical angle shall not exceed 18 degrees. All gears shall be AGMA Quality 10 or higher as outlined in AGMA Classification Manual 390.93. All gears shall be inspected in accordance with best accepted practice and shall be certified as to meeting the specified quality. In establishing the capacity of the unit to transmit power, the following AGMA standards for surface durability, strength and materials shall govern:

Spur gearing and helical gearing.	AGMA 210.02	
	AGMA 211.02, 211.02A, 211.02B	
	AGMA 215.01	
	AGMA 220.02	
	AGMA 221.02, 221.02A, 221.02B	
	AGMA 225.01	
	AGMA 226.01	
	AGMA 241.02	
	AGMA 245.01	
	AGMA 420.02	
	AGMA 440.03	
	Worm Gearing.	AGMA 241.02
		AGMA 243.51
		AGMA 245.01
ABMA 440.03		

All gears shall be wrought or alloy steel except worm gears shall be bronze. The gear teeth may be through-hardened, contour-induction-hardened, nitrided, or carburized. Flame-hardened gears will not be acceptable. The housing shall be of high quality close-grained cast-iron or fabricated steel. Gearing shall be splashed oil lubricated. Bearings shall be grease lubricated. A key seat shall be provided on the output shaft to fit the key specified for attachment to the pump coupling; key seat shall conform to ANSI Standard B17.1 or B17.2 as appropriate.

10. PUMP INSTALLATION shall conform to applicable manufacturer's recommendations and specified requirements as indicated.

10.1 Vertical turbine pumps shall be installed directly on the concrete tanks using the manufacturer's recommended support plate anchored in position by steel anchor bolts cast in the concrete.

10.2 All pumps shall be installed plumb and level to maintain suction and discharge flanges or opening in a true vertical or horizontal alignment. Pumps shall be shimmed with steel shims of appropriate thicknesses to level the pump and be of sufficient width to reduce torsional stresses or distortions caused by bolting down. The shimmed base shall be packed full with a non-shrink cement grout after all leveling is complete and the pump base is bolted into position.

10.3 Pump stations for Sites I-H, VII-G, X-2, MCAS-L, and MCAS-Z shall be reinforced concrete pipe, Class III or Class V as indicated. Precast concrete structures shall be acceptable provided they meet the dimensions shown and are designed to withstand the earth pressure loadings.

10.4 All piping (suction and discharge) shall be supported near the pump to prevent undue pipe loads on pump flanged or threaded connections and to permit removal of the pump without removing the piping system. Piping shall be direct and consistent with the plans to minimize undue bends, restrictions or smaller sizes on suction piping.

10.5 All pumps shall be manually rotated to assure free rotation prior to any powered starting. Pump rotation shall be checked by motor jogging to assure proper rotation and any pump that can be damaged by incorrect rotation should be uncoupled for rotational checks with power to the electric motor.

10.6 Rotating equipment shall be doweled with steel dowel pins after all alignment has been completed and verified. Doweling shall be installed only where recommended by the equipment manufacturer.

10.7 Pipe installations at all pumps shall conform to the requirements of the section entitled "Process Piping and Valves".

10.8 Electrical motors shall be connected to electric services in accordance with the section entitled "Interior Electrical Systems".

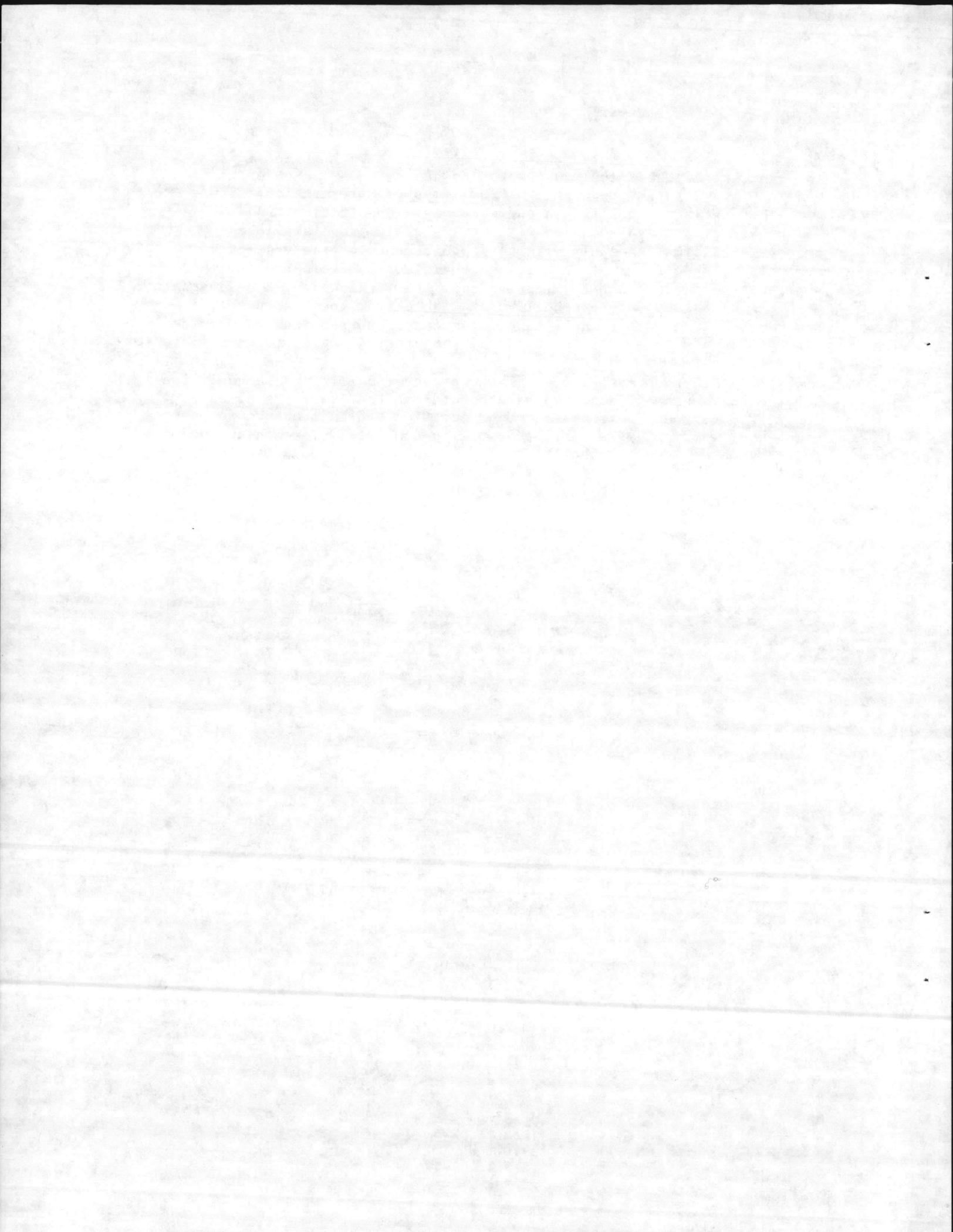
11. TESTS AND START UP:

11.1 Each pump shall be certified by the pump manufacturer from a "Certified Performance Curve" which has been developed from a like size pump, not the actual pump to be installed. The curve shall show the pump size, pump number, impeller diameter, speed, brake horsepower, efficiency, and shut off head.

11.2 Each pump system shall be tested with water prior to the introduction of the actual wastewater to be tested. The water tests shall include static pressure and flow tests to determine compliance with the contract requirements and warranty. Specific settings of valves and controls associated with the specific pumps shall be accomplished simultaneously with the requirements of the respective controls as specified in the sections entitled "Controls and Alarms". Appliances and equipment for testing shall be furnished by the Contractor at his own expense. Water shall be available from the Government, however, the Contractor shall make all connections required to provide water to each system. All systems shall be tested until proven satisfactory.

11.3 Start up assistance: The Contractor shall furnish qualified service engineers of each pump manufacturer of the pumps installed to instruct Government personnel in the operation and maintenance for one eight-hour working day after the system is complete. The scheduling of the service engineer(s) shall be coordinated with the Government to assure availability of personnel and prevent excessive number of service engineers at the site at any one time.

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SECTION 15471. MISCELLANEOUS MECHANICAL EQUIPMENT

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 American Gear Manufacturer's Association Standards (AGMA):

390.03-73 Gear Classification Manual

1.2 American Institute of Steel Construction (AISC):

AISC-19 Specifications for the Design, Fabrication and
Erection of Structural Steel for Building.

1.3 American National Standards Institute (ANSI):

B17.1-67 Keys and Keysets
B17.2-67 Woodruff keys and keysets.

1.4 Redwood Inspection Service, California Redwood Association

2B1-2 Standard specification for grade of California
Redwood Lumber

2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" with the following additions and modifications, applies. The work includes the equipment herein specified complete and ready for use.

3. SUBMITTALS REQUIRED: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists:

3.1 Manufacturers Data:

Mechanical Sludge Collector
Skimmer Dam Equipment
Fuel Dispenser
Shut-off Nozzles

3.2 Shop Drawings:

Mechanical Sludge Collector
Skimmer Dam Equipment
Fuel Dispenser
Shut-off Nozzles

4. MECHANICAL SLUDGE COLLECTOR: The Backwash Waste Settling Tank at Site VII-9 shall be provided with a dual rectangular mechanical sludge collector driven by a single motorized speed reducer. The collector mechanism shall be chain-and-flight type designed to move settled sludge to the sludge hopper. The mechanism shall include a sludge collector assembly and drive assembly. Each collector mechanism shall be protected from overload by means of replaceable shearpins located in the shearpin hub of the drive sprocket.

4.1 Design. The sludge collector assembly shall operate at a linear speed between one to two feet per minute. The clarifier mechanism and its component parts shall be designed, with a minimum factor of safety of four, to withstand all structural and mechanical stresses brought about by the drive assembly and the following loadings: dead load and a sludge load equal to a horizontal load of eight pounds per linear foot of scraper blade in a scraping position. The mechanism shall be designed for continuous 24-hour service under design load without excessive wear, damage, or failure. The mechanism shall be capable of operating in a dry tank without overloading the equipment. Stresses developed under the aforementioned operating conditions and loads shall not exceed the allowable stresses conforming to AISC Specification for the Design, Fabrication and Erection of Structural Steel for Building.

4.2 Sludge collector assembly includes collector chain, drive sprockets, idler sprockets, shafts, bearings, collector flights and rails.

4.2.1 Collector chain shall be the heavy pintle type 720S having an average ultimate strength of 37,500 pounds and shall weigh no less than 5.2 pounds per foot. Chain links shall be of corrosion resisting malleable iron having average tensile strength of 70,000 pounds per square inch and an average Brinell hardness between 170 and 190. Attachments for scrapers shall be full depth of scraper and attached with four bolts. Pivoted chain attachments shall be provided for at least two scrapers on each collector so designed as to assure positive cleaning of tank corners. All special links shall be of the same material as the main chain links. Coupling pins shall be not less than three-fourths inch diameter heat treated high carbon steel. All cotter pins shall be stainless steel.

4.2.2 Sprockets for collector shall be high-test cast iron, having a minimum tensile strength of 20,000 pounds per square inch cast in a chill, and shall have a Brinell hardness of not less than 360 with a chill depth of at least three-sixteenth inch. Sprockets shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit chain. Sprockets shall be split construction assembled with cadmium plated nuts and bolts. Driven sprocket on the head-shaft shall be of the offset type. The three sprockets on the head shaft shall be key seated. The idler and chain take-up shaft sprockets shall not be key

seated but, except for number of teeth, shall be identical in other respects to the head shaft sprockets. On each idler and take-up shaft, one sprocket shall be set-screwed and one sprocket shall turn free between two set-screwed collars.

4.2.3 Shafting shall be solid, cold-finished steel, straight and continuous for full width of tank. Shafting shall be of sufficient size to transmit the maximum force developed by the drive assembly. Collars and keyways shall be provided where necessary to attach or locate sprockets on shafting. Keys and key seats shall conform to ANSI B17.1 or B17.2. Shafting shall be polished in areas of contact with bearings.

4.2.4 Bearings shall be babbitt-lined, self-aligning ball-and-socket type. All bearings, except those at chain take-ups and those for bracket-supported driven sprockets, shall be bolted to the tank walls. Bearings shall be designed to allow minimum field variations without shimming. No bracket supports, except on head shaft driven sprocket shall be allowed. Bearings above water shall be provided with flush ball-check grease-lubrication fittings. Underwater bearings shall be water lubricated with tops designed to prevent solids accumulation. Underwater bearings shall be equipped with flush ball-check grease-lubrication fittings for use during initial operation and at times when the tank is dewatered. Take-up bearings shall be self-aligning, shall be arranged to slide between or to be steadied by two cast iron, mild steel or silicon bronze guides. Take-up bearings shall have a minimum range of travel of 10 inches and shall be positioned by a stainless steel or silicon bronze threaded power bolt which shall be arranged for locking at any position of the bearing. All bearings shall be rated for a minimum of five years continuous service condition.

4.2.5 Collector flight shall be made of Select Heart California Redwood graded in accordance with the Redwood Inspection Service, Standard Specifications for Grades of California Redwood Lumber. Flights shall be two inch by six inch nominal size extending the full width of the tank with one-half inch clearance at each end. Flights shall be spaced at 10 foot intervals. Wearing shoes shall be provided on each flight to run on tee rails on the tank bottom and on angle tracks for the return run. Wearing shoes shall be fabricated of three-eighth thick steel angles, case hardened to a minimum Brinell hardness of 555. Wearing shoes shall be as wide as the flight thickness and one inch longer than the width of the bottom rail. Flights shall be accurately drilled and notched at the factory and shall be carefully grouped and banded together for shipment. Spring brass squeezes shall be provided on each side of two equally spaced flights in the settling compartments to provide positive cleaning and scraping of the sides of the tank.

4.2.6 Rails and tracks. Two industrial type steel rails, minimum weight 25 pounds per yard each, shall be provided for each collector mechanism. Rails shall be provided in approximately 35 foot long sections except as necessary for closure of run. All necessary splice bars, rail

clips, and appurtenances shall be included. Return tracks shall be structural angles having a minimum thickness of three-eighths inch and shall be supported by wall brackets. Tracks shall be located so as to position flights for skimming on return run.

4.3 Drive assembly shall include an electric-motor-driven speed reducer; drive sprocket on output shaft of speed reducer; drive chain from drive sprocket to driven sprocket; shear pin; and chain guard. Unit shall be fully enclosed and designed for mounting outside and exposed to the weather.

4.3.1 Gearing shall be worm or helical type, fully enclosed and running in oil with antifriction bearings throughout.

4.3.2 Bearings incorporated within the drive assembly shall be of the antifriction type, shall run in oil, and shall conform to the following minimum schedule of rated-life expectancy (L-10) based on the Antifriction Bearing Manufacturers Association Standards when operating under the normal continuous operating load.

Gearbox bearings	L10-100,000 hours
All other bearings	L10- 40,000 hours

4.3.3 Chain and sprocket drives incorporated in the drive assembly shall be designed with a minimum factor of safety of four as applied to the ultimate breaking or transmission strength of the chain with respect to the loads transmitted at normal continuous operating load. Chain and sprockets connecting motor and speed reducer shall be enclosed in a weatherproof fabricated steel or fiberglass guard. Chain connecting motor and speed reducer shall be steel roller type. Sprockets shall be hardened ground alloy steel or high-test cast-iron, having a minimum tensile strength of 40,000 pounds per square inch cast in a chill, and shall have a Brinell hardness of not less than 360 with a chill depth of not less than three-sixteenth inch. Sprocket teeth shall be accurately ground to fit the chain. The drive sprocket on the output shaft of the speed reducer shall be bronze bushed with a grease-lubricated bronze bushing and provided with shear pin overload protection. Drive chain shall be pintle type chain and, except for pitch weight and class, shall meet the general requirements for collector chain as specified herein. A drive chain tightener, capable of being operated from the top of the tank, shall be provided to adjust and tighten the chain.

4.3.4 Drive motor shall be constant speed, totally enclosed, NEMA type approved for outdoor service. Motor shall be directly connected to the speed reducer through a flexible coupling. Motor and speed reducer shall be mounted as a unit on the same baseplate.

4.4 Spare parts which are identical and interchangeable shall be furnished, carefully boxed or packaged, and plainly marked for reordering. The following parts are required.

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4.4.1 Collector chain. Ten collector chain links and four collector chain attachment links for each longitudinal channel.

4.4.2 Drive chain. One complete drive chain. Four drive chain links for each longitudinal channel.

4.4.3 Collector flight wearing shoes. Fifty percent replacement of all collector flight wearing shoes furnished including bolts, nuts, washers, lockwashers, and similar parts.

4.4.4 Collector flights. Twenty-five percent replacement of all collector flights furnished. Collector scrapers shall be machined for all attachments. Each collector flight shall include all bolting material except for wearing shoes.

4.5 Control. Mechanical sludge collection equipment shall be manually controlled or automatically controlled by the sequence timer as specified in Section "Controls and Alarms".

5. SKIMMER DAM EQUIPMENT: Where indicated, Skimmer dams shall be provided on drainage streams at the Marine Corps Air Base-New River. Skimmer dams shall include concrete retaining wall for support of the floatable oil spill containment boom and float riser track assembly. Boom equipment shall be impervious to acids, caustics and solvents.

5.1 Floatable Boom. Floatable boom shall be provided with float, skirt baffle, load support cable and boom connectors and all fasteners and anchor points as required by manufacturer.

5.1.1 Float shall be 6.5 inches diameter bright yellow modified polyethylene foam. The foam shall be processed to impart a solid polyethylene skin over the entire surface. Ultraviolet and oxidation inhibitors shall be incorporated in the foam for durability and extended life. Float boom shall be provided in lengths indicated in increments of 60 inches.

5.1.2 Skirt Baffle. Skirt material shall be woven heat set polyester fabric coated with orange polyvinyl chloride with ultraviolet inhibitors and anti-oxidant additive for longer life. Temperature range shall be from -20°F to 200°F. The skirt material breaking strength shall be in excess of 430 pounds by 340 pounds.

(a) Ballast shall be lead weight securely bolted or riveted to the bottom of the skirt. Ballast shall be provided as recommended by the boom manufacturer.

5.1.3 Load support cable and boom connectors shall be one-half inch high tensile braided polyethylene rope. During use, loads imposed on the boom shall be transferred to the rope through numerous attachments

along the floats and at every anchor point. Polyethylene interlocking boom connectors shall allow any sections of boom to be bolted together.

5.1.4 All fastenings shall be non-metallic.

5.2 Float Riser Track Assembly. The float riser track assembly shall be used as a permanent installation where the boom must be able to rise and fall with changes in the water level. The assembly shall provide a watertight seal between the boom and the point of attachment to the riser track.

5.2.1 The riser shall be provided with floats, rollers and roller skate seal which shall be attached to the riser track "I" beam and mounting plate. As the water level rises or falls, the riser shall also rise or fall. Riser shall be aluminum (anodized).

5.2.2 The float riser track shall consist of an "I" beam track and mounting plate as indicated on the drawings. The riser assembly shall move up or down on the track by the use of rollers attached to the "I" beam.

5.3 Installation of the skimmer dam equipment shall be in accordance with the manufacturer of the floatable boom and float riser track assembly.

6. FUEL DISPENSER: Fuel dispenser shall be provided at Site IV-D as indicated. Fuel dispenser shall be provided with cabinet fuel pump. Motor shall be one-fourth horsepower explosion-proof type suitable for 115 volt, 60 hertz, single phase service. Dispenser shall be provided with a heavy-duty on-off switch. Exterior housing shall be corrosion resistant material, weatherproof construction. No foot valve shall be required. Check valve, bypass valve and strainer may be combined into one unit. Pump shall supply 15 gallons per minute. Hose shall be 10 feet long by 3/4 inch diameter provided with automatic shutoff nozzle as specified below.

7. AUTOMATIC SHUTOFF NOZZLES: Where indicated, automatic shutoff nozzles shall be provided for fuel dispenser hose connections. Nozzles shall automatically shutoff when gasoline in tank covers tip of nozzle tube. Flow shall be adjustable from a trickle to full stream at 12 gallons per minute discharge. Nozzles shall shutoff automatically at flows. Nozzle shall be constructed of lightweight and high strength aluminum. Nozzles shall be one inch in diameter and curved for easy entry into tanks.

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SECTION 15482. CONTROLS AND ALARMS

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

1.1 Federal and Military Specifications:

GG-G-76D Gages, pressure and vacuum, dial indicating.

1.2 American Society for Testing and Materials (ASTM):

B88-76 Seamless copper water tube.

1.3 National Fire Protection Association (NFPA):

70-1978 National Electrical Code.

2. GENERAL REQUIREMENTS: Section 15011, "General Requirements, Mechanical" and Section 16011, "General Requirements, Electrical" with the following additions and modifications, applies. The work includes control and alarm systems for pumps, motor operated valves and tank high level alarms complete and ready for use.

3. SUBMITTALS REQUIRED: The submittal requirements of the Section entitled "General Requirements, Mechanical", applies to the following lists.

3.1 Manufacturers Data:

- (a) Alarm Systems
- (b) Bubbler Systems
- (c) Timer Controllers
- (d) Pressure Switches
- (e) Float Switches
- (f) Temperature Switches

3.2 Shop Drawings:

- (a) Bubbler Panel
- (b) Annunciator Panel
- (c) Wiring Diagrams (Schematics and one line)
- (d) Hydraulic/Pneumatic Diagrams

4. MATERIALS AND EQUIPMENT:

4.1 Temperature switch (indicated as thermostat) shall be provided in a NEMA 4 enclosure with a bottom connection. Switch shall be vapor pressure activated bourdon tube type with magnetic mercury switch contacts. The operating point shall be adjustable on the outside of the case. The operating range shall be 100 degrees/200 degrees Fahrenheit and the instrument shall withstand a temperature of at least 220 degrees (F). Switch shall be provided with a remote sensing bulb and one-eighth inch copper tube connection to the switch. Switch shall close the contacts on rising temperature and shall be suitable for 120 volt A.C. control circuit voltages.

4.2 Pressure Switches shall be pressure operated mercury switches with adjustable operating point and adjustable differential. Pressure switch range shall be 10 to 200 pounds per square inch unless indicated otherwise. Switch operating points shall have external means of adjusting the set points and the set points shall be clearly indicated without disassembly of the switch or its enclosure. Pressure switches shall be in explosion-proof (Class 1, Group D, Div. I) NEMA 7 enclosures when installed in any fueling system. Pressure connection shall have a one quarter inch treaded female connection. Control circuit voltage shall be 120 volts single phase.

4.3 Float Switches:

4.3.1 Float Switches for fuel tank high level alarms shall be a mercury switch enclosed in an explosion proof (Class 1, Group D, Div. I) NEMA 7 enclosure. The mercury switch shall be actuated by a magnetic armature attached to the float rod. Float and float rod shall be Type 304 stainless steel with a minimum float diameter of 4-1/4 inches. Float rod shall be at least five feet long and shall have two adjusting collars to position the float on the rod. Float switches shall be suitable for mounting as indicated and for 120 volt, single phase control voltages. Float switches shall close the contacts at high level. The liquid level differential between opening and closing the switch shall be at least one inch in fuel with a specific gravity of 0.90. Float switch shall include a 150 pound ASA flanged mounting plate.

4.3.2 Float Switch Control for Pumps. The pumps and alarms shall be operated off the liquid level in the pump station wet pit by mercury switches encapsulated in a polyurethane foam or polypropylene bulb and covered with a heavy neoprene rubber jacket. Float settings will be as indicated. Each float shall be weighted so that it will hang vertically and to prevent sharp bends that would damage the conductors in the cord when the float operates under water. Four float switches shall be provided for each duplex pump station to control the level - one for pump turn on, one for pump turn off, one for both pumps turn-on, and one for high level alarm. For storm water storage tanks, a fifth float will be provided to actuate a remotely located butterfly valve. The control system shall include an alternating relay to change the lead-lag pump, each cycle high level alarm relay, high level alarm light, audible alarm,

terminal strips, and all associated wiring and connections required for a complete operational system. Control voltage shall not exceed 120 volts alternating current and a properly sized transformer shall be incorporated in the panel to supply 120 volts where required. Each mercury float switch shall be directly connected to the control panel without splicing by a neoprene jacketed submersible cable of No. 18 AWG (minimum) conductors. Extra cable length shall be provided and coiled in the wire channel for adjusting float set point.

4.4 Limit Switches shall be provided on valves where indicated to provide control function or position signals as specified. Limit switches shall be snap action, spring return and may be either plunger or lever actuated. Switches shall be rated for 120 volts service and shall be in NEMA 7 enclosure.

4.5 Bubbler Control System.

4.5.1 General. A pneumatic bubbler system shall control the operation of the pumps and other components by measuring the liquid level in the wet well. The enclosures and electrical work shall conform to the requirements of the section entitled, "Interior Electrical Systems". The compressed air equipment is specified in the section entitled "Compressed Air System".

4.5.2 Bubbler control system. Air shall flow from the compressed air system through an adjustable flow regulator and filter mounted in the control panel through the bubbler tubing to the tanks as indicated. The Contractor shall make connections into and out of the control cabinet via terminal fittings provided by the manufacturer. A moisture filter, pressure reducing valve with up and downstream two inch diameter air pressure gauges, an adjustable air flow regulator, shut off and bleed valves, and a four and one-half diameter liquid depth gauge flush mounted in the cabinet door shall be included for each bubbler system. The liquid depth gauge shall be calibrated in feet to reach directly true liquid depth. Each pump shall be controlled by pressure sensor assemblies with independent diaphragm for each pump, one for start and one for stop. The stop switch shall be common to both pumps. Pressure sensors shall be adjustable in the field without special tools over the entire control range of one to 20 feet head. Pressure switch shall also be provided for alarm functions as specified hereinafter. The pressure switches shall have restricted mechanical movement and shall operate its own hermitacally sealed mercury switch. High pressure, push button operated, purging shall be provided and shall include necessary two-way and three-way solenoid valves with time delay to prevent damage to control level sensors. Controls shall be adjusted to operate the pumps and alarms over the set liquid depths indicated. The "lead" pump shall start and when the wet well depth exceeds the range of the "lead" pump, the standby pump shall start. Both pumps shall operate until the low level pump stop setting is reached in the wet well. An electric alternator shall automatically alternate the "lead" and standby pump position after each pump cycle.

4.5.3 Bubbler system pneumatic piping is specified in the section entitled "Piping and Valves".

4.6 Sequence Controller or Cam Timer shall have a time range of 180 minutes and shall be driven by a heavy duty synchronous motor. The timer shall have 6 cams which shall be adjustable over a range of 2 to 98 percent of the total 180 minute cycle. Cam switches shall be snap type and shall be secured to the frame by a push-in type retainer. No special tools shall be required to replace cam switches. The entire cam stack shall have the capability of being rotated manually. Programming shall be by turning adjustment screw for each cam.

4.7 Repeat Cycle Timer shall have a 10 minute cycle with the on period adjustable from 0 to 90 percent of the cycle. Timer shall be driven by a heavy duty synchronous motor. Timer shall provide ON-OFF operation by manually setting to such position indicated in the timer dial.

4.8 Pilot Lights shall be provided as indicated and shall have neon lamps suitable for 120 volt power.

4.9 Pushbutton and Selector Switch Stations shall conform to the requirements of the section entitled "Interior Wiring Systems".

4.10 Name Plates shall be provided for all control panel switches, lights and alarms as indicated. Push button shall have the button function engraved in the face of the button. Selector switches shall have standard size liquid plates identifying the selector functions. Other components shall have laminated plastic name plates securely attached to the panel face as indicated. Lettering shall be black on a white background.

4.11 Control Panels shall conform to the section entitled "Interior Wiring Systems" except as indicated or specified herein. All panels shall be completely assembled and tested at the factory before shipping. All required power components and the relays, interlocks and internal wiring necessary for the system to function as indicated shall be provided and connected to terminal strips for connection to external circuits. A 120 volt transformer shall be included in all control panels to provide 120 volt power to operate controls and valves. The transformer shall be preceded by a fuse. The transformer and fuse shall be sized in accordance with NEC requirements for the single phase loads indicated. Provide also 1 pole, 20 ampere breakers for single phase circuits as indicated.

4.12 Motor Operated Valve Controls shall be coordinated with the motor operator and shall be fully assembled in the control panel cabinet ready for connection to external control and power circuits. The control shall provide for automatic and manual operation of the motor operated valves and shall include the following components:

4.12.1 Separate Control Circuits for automatic opening, stopping and closing of the valve.

4.12.2 Selector Switch and Pushbutton Station for manual operation of the valve. Pushbutton shall be provided to open, close or stop the valve.

4.12.3 Indicating Lights for valve positions. One light for open, one for closed and both lights illuminated when valve is in intermediate position.

4.13 Alarm Relay at the MCAS-G Site. Whenever the valve closes because of high level in either tank, an alarm circuit shall be activated. Separate circuits shall be provided for each tank and separate red lights for each tank. The alarm shall include a horn which shall sound upon a high level condition in either tank. A silence button shall be provided for the horn but the red lights shall remain illuminated until the high level ceases to exist. A circuit shall also be provided for connection to a remotely located alarm station.

4.14 Control System Disconnect Switch - One pole, 120 volt, 20 amp capacity.

4.15 Other components as indicated and as required to provide the functions indicated and specified.

4.16 Alarm System:

4.16.1 General. The alarm system component shall be incorporated into either the motor control center, control panel enclosure and a separate metal enclosure as indicated conforming to the requirements of the section entitled "Interior Electrical Systems".

4.16.2 Annunciator equipment shall be built with materials and construction adequate for a minimum of 10 years service. The annunciator shall provide local audible and visual signals to indicate the alarm conditions for high level and other conditions indicated. The annunciator components shall be solid state plug-in module type and shall be epoxy resin cards with copper printed circuits and gold flashed contacts. All components (including transistors) on card shall be solid state and shall be soldered to reduce any possibility of malfunction due to poor connections. There shall be one alarm module per trouble contact. Multialarm modules are not acceptable. Each alarm module shall have a slide switch to allow choice of accepting either normally open or normally closed field trouble contact. One flasher/audible module shall be common to each entire system. Annunciator panels and components for hazardous locations shall be suitable for Class I, Group D locations and shall provide functional and operational characteristics specified above except hermetically sealed plug in relays may be used in lieu of solid state.

4.16.3. Operating Characteristic. Each alarm point shall be capable of sounding audible signal or signals independent of the status of all other alarm points in the system. Each alarm point shall be properly controlled by any common pushbutton (such as Silence and Test) independent of the status of all other alarm points in the system. Ambient temperature range shall be 20 degrees Fahrenheit to 120 degrees Fahrenheit. Line voltage fluctuations of up to ±10% will not result in annunciator malfunction.

Plug-in modules shall be operable from normally open field contacts that close on fault or normally closed that open on fault. That is, it shall not be necessary to change plug-in assembly when going from one type of actuating contact to the other.

Further, only one common lead for all field contact plus one additional lead per field contact shall be required independent of whether normally open, normally closed or both types of contacts are used for actuating the annunciator.

4.16.3.1 Sequence of operation. Each alarm point shall follow the operation shown in chart form as regards to lamp, audible signal and common pushbutton operation:

	<u>Condition</u>			
	<u>Normal</u>	<u>Alert</u>	<u>Silence</u>	<u>Return to Normal</u>
Visual Indicator	Off	Flashing	Steady Bright	Off
Audible Signal	Off	On	Off	Off

It shall be possible to cause momentary alarms to lock in or not by means of a convenient switch change on the plug in module. "Lock-in" shall hold annunciator point in "Alert" condition until the operator accomplishes "Silence" once the associated trouble contact changes to its off-normal state independent of whether or not the contact returns to normal in this period. "Test" shall be full functional by means of one common pushbutton.

4.16.3.2 Backlighted nameplate type cabinets shall be provided where indicated. Backlighted nameplate visual alarm indicators may also be used in lieu of panel mounted red lights (Contractor's Option) where NEMA 1 or NEMA 12 panels are required. Light boxes shall be furnished having individual hinged doors such that lamp replacement can be made on a point basis without disturbing the register of nameplates to lamps of complete assembly; making identification of alarms positive even when they occur during lamp changeout. Two lamps connected in parallel shall be furnished for each alarm point. Nameplates shall be permanently fastened to light box and not separated therefrom for purposes of lamp change so as to avoid the possibility of replacing nameplates in the

wrong annunciator position, if two or more are removed at one time. Plug-in design and construction shall be followed both as regards light boxes and relay assemblies. Cabinet wiring shall be universal such that annunciator sequence of operation can be changed from any standard originally furnished by the manufacturer to any other standard of same manufacturer simply by substituting plug-in assemblies. Further, it shall be possible to substitute for standard single point plug-in assemblies, other standard dual assemblies increasing the capacity of the system to two, independent, alarm points per cabinet position. Manufacturer's regular, flashing sequence shall be acceptable for purposes of this dual substitution requirement. Design and construction shall be such that plug-in, common pushbuttons may be made a part of the cabinet assembly. Provide appropriate entrance to cabinet for field connections and power supply.

4.16.3.3 Visual Alarm Indicators:

4.16.3.3.1 Panel mounted red light alarm indicator shall be red neon pilot lights with and identifying nameplate below the light. Explosion-proof lights shall be used where Class I, Group D equipment is indicated.

4.16.3.3.2 Red alarm indicator lights mounted external to the panel shall be a 175 watt mercury vapor lamp mounted in a weatherproof housing. Housing shall be cast aluminum with a cast aluminum guard and heat resistant, red glass globe. Units shall be suitable for wall (angle) mounting or vertical mounting on top of panels as indicated.

4.16.3.3.3 Where red lights are indicated to be suitable for hazardous locations, Class I, Group D, Division 1, the light shall be a rotating red beacon. Rotating beacons shall mount on conduit box, shall have a reflector revolving around a fixed spot lamp and shall have a heat resistant lense with lense guard.

4.16.3.4 Audible alarm shall be a single projector electric horn with a decibel rating of 104 at a distance of 10 feet. Horn shall operate on 120 volts, single phase, 60 Hertz electric service. Horns mounted outside the control panel shall be suitable for hazardous locations, Class I, Group D where indicated and in a weatherproof cast aluminum housing for other outside locations.

4.17 Relays shall have contacts that can be field converted from normally open to normally closed.

5. ELECTRICAL COORDINATION AND DRAWING REQUIREMENTS:

5.1 The motor control panels required for proper operation of the equipment are specified in the section entitled, "Interior Wiring Systems". The Contractor shall coordinate the motor control panel construction requirements with the control and alarm system requirements

to assure compatibility, proper alignments, spacing, terminals and other accessories required for the specified operation of the pumps and valves. Control components shall be included in the motor control panels unless indicated otherwise.

5.2 Complete drawings of the equipment including a complete detailed description of operation, shall be submitted for approval. Drawings shall include standard schematics, outline dimensions, external connection diagrams, internal pneumatic schematics, and a complete bill of material. The description of operation shall be complete, contact by contact, relay by relay, and shall completely describe the operation of the control circuits and devices in terms which will be comprehensible.

5.3 Complete master wiring diagrams, elementary or control schematics, including coordination with other electrical control devices operating in conjunction with the motor control panels and suitable outline drawings shall be furnished for approval before proceeding with manufacture. The drawings shall be clear and carefully prepared to facilitate interconnections with all other electrical equipment.

5.4 All control voltage shall not exceed 120 volts, single phase, 60 Hertz, alternating current.

5.5 Hazardous Locations. Panels, alarms and control components where indicated shall be in enclosure suitable for Class I, Group D, Div. I locations. In such locations, the Contractor may provide a single panel as indicated or may provide a group of smaller panels provided all functional requirements are met and the group of panels can be arranged neatly in an orderly arrangement in the space available.

6. INSTALLATION REQUIREMENTS:

6.1 Components that are provided during the progress of the work shall be properly protected from damage during the remaining construction phase. Components shall not be installed where they may temporarily support the load of pipe or equipment.

6.2 Components damaged during construction shall be replaced by the Contractor at no additional expense to the Government.

6.3 Electrical work shall conform to the requirements of the sections entitled "Interior Wiring Systems" and "Exterior Electrical Systems". Connections to all components shall be contained in flexible connections as specified in the section entitled "Interior Wiring Systems".

6.4 Grounding of specific components shall conform to the National Electric Code. Ground conductors are not indicated, however they shall be provided for all control and alarm components as required by the NEC.

6.5 Conduit systems shall be supported from the structural components, contained within the buried duct system, or contained in buried conduit to remote locations as indicated.

6.6 Pneumatic piping shall be installed along structural members or attached to pipe or conduit lines that are not subject to high temperatures. Pneumatic lines shall not be attached to any steam or condensate line.

6.6.1 Compression female type fittings of polypropylene, brass, or stainless steel shall be used. Fittings must be compatible with tubing material and conform the pressure.

6.6.2 Attachment to pipes shall be by plastic or stainless steel banding spaced at 2-foot intervals to prevent sagging between straps and assure support in the event straps fail from improper use or accidental loads.

6.7 Control components to be housed in the motor control panel or separator panels as indicated shall be provided in compliance with the manufacturer's recommendations.

6.8 Fuel storage tank level switches:

6.8.1 The installation of pipe flanges in the existing manhole covers of fuel storage tanks that shall receive level alarms shall be coordinated with the Contracting Officer. No welding shall be permitted at the tank locations. The covers must be removed from the tank nozzle for all modifications. Temporary covers must be provided to prevent contamination of fuels and accidental entry into the tank.

6.8.2 Welding of the float access nozzle in each tank manhole cover shall be in accordance with ANSI B31.1. Joints shall be assembled by fusion welding and the Contractor shall be fully responsible for the quality of the welding. The Contractor shall conduct tests not only of the welding procedure used by his organization, but also of the welding operators to determine the ability of the operators to make sound welds under standard conditions. Float access nozzle shall be Schedule 40 steel pipe with a 150 pound ASA flange.

6.8.3 Welded joints between pipe nozzle and tank manhole covers shall be reinforced against external strains. All welds shall be cleaned of slag and the manhole primed and painted in accordance with the section entitled "Field Painting".

6.8.4 Gaskets shall be Buna-N rubber between all flanged joints. Gaskets at removed manhole covers shall be replaced with 1/8 inch thick Buna-N rubber gaskets.

6.8.5 Alarm system components shall be assembled and connected according to the manufacturer's recommendations.

6.9 Connections into existing control panels shall be performed carefully to prevent damage to existing equipment and changes in the mode of operation of the existing system.

7. TESTING:

7.1 Bubbler system shall be tested at operating pressure using a liquid soap test at all joints. Leaking joints shall be tightened or replaced with no pressure in the system. The system shall be retested at the tightened joint only and a minimum of two joints on each side away from a completely replaced joint.

7.2 Electric system shall be tested for continuity and resistance shall be measured and recorded for each system loop.

7.3 Functional tests of each system shall be completed prior to start up to assure proper sequencing of the control portions.

8. INSTRUCTING OPERATING AND MAINTENANCE PERSONNEL: Upon completion of the work at a time designated by the Contracting Officer, the services of a competent manufacturer's representative shall be provided for a period of not less than one 8-hour working day for the instruction of the Government operating personnel in the proper operation and maintenance of the equipment.

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SECTION 15651. HEATING AND VENTILATING

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

1.1 Military Specification (Mil. Spec.):

MIL-F-16081G	Fans, Ventilating, Propeller
MIL-L-18145C	Louver, Meta; Exhaust Opening and Gravity Closing Type

1.2 Air Moving and Conditioning Association (AMCA) Publications:

210-74	Test Code for Air Moving Devices
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1.3 American Society of Heating, Refrigeration & Air Conditioning Engineers (ASHRAE) Publications:

1975	Equipment; Handbook and Product Directory
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1.4 American Society for Testing and Materials (ASTM) Publications:

A525-76	Steel Sheet, Zinc. Coated (Galvanized) by the Hot Dip Process
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1.5 National Fire Protection Association (NFPA) Publications:

70-78	National Electrical Code (ANSI C.1)
90A-76	Air Conditioning and Ventilating Systems

1.6 Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Publications:

1976	Low Pressure Duct Construction Standards
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2. GENERAL REQUIREMENTS: Section 15011, General Requirements, Mechanical, applies to this section, with the additions and modifications specified herein.

2.1 Description of Work: The work includes providing new heating and ventilating systems, and related work. Each system shall be complete and ready for operation. Equipment, materials, installation, and workmanship shall be in accordance with NFPA 70, 90A, except as specified or indicated otherwise. Capacity and efficiency of equipment shall be not less than that indicated. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. Contractor shall rough-in for and shall

make duct connections to equipment furnished under other sections of this specification.

2.2 Submittals Required: The submittal requirements of Section 15011, General Requirements, Mechanical, applies to the following lists.

2.2.1 Manufacturer's Data:

- a. Exhaust Fans
- b. Units Heaters
- c. Temperature Control Systems

2.3 Insulation: Piping and equipment shall be insulated under Section 15181, Insulation of Mechanical Systems.

3. EQUIPMENT:

3.1 Exhaust Fans: Mil. Spec. MIL-F-16081, Type I, Class 1 for direct drive, Class 2 for belt drive, style A for wall or window mounting, Style B for roof or ceiling mounting, except that fans shall be centrifugal type with aluminum housing, wheel and bird screen. Motors shall be completely shielded from the air stream. Provide exhaust opening and gravity closing type automatic louvers conforming to Mil. Spec. MIL-L-18145. Capacity of fans shall be certified in accordance with AMCA-210, and shall be not greater than 110 percent of the capacity indicated at indicated pressure drop.

3.1.1 Each exhaust fan for the bathroom building at Site VIII-1 and the Control Building (upper level) at Site VII-9 shall have capacity of 463 c.f.m at one-eighth inch static pressure. Motor shall be one-twelfth horsepower with fan speed of 860 rpm. Voltage shall be as indicated.

3.6.2 Exhaust fan for Sludge Pump Pit at Site VII-9 shall have capacity of 725 c.f.m. at one-fourth inch static pressure. Motor shall be one-twelfth horsepower with fan speed fo 860 r.p.m. Voltage shall be as indicated.

3.1.3 Exhaust fan for Sludge Pump Pit at Site VII-9 shall be controlled by time clock. Time clock shall be 24-hour programmable type with 96 fifteen minute intervals. Clock shall operate on 120 volts, 60 hertz alternating current and shall have a capacity of 15 amperes. Clock shall be housed in a NEMA 1 enclosure. Provide HOA selector switch with pilot light.

Exhaust fan for the Control Building (upper level) at Site VII-9 shall be controlled by a manual starter "on-off" switch as specified in Section entitled "Interior Wiring Systems".

Exhaust fans for the Bathroom Building at Site VIII-1 shall be controlled by a manual preset timer. Timer switch shall be provided for

operation of each exhaust fan at the Bathroom Building at Site VIII-1. Timer shall have setting from 0 to 15 minutes. Timer shall be set in clockwise direction, and time out in counterclockwise direction. Time shall be provided with positive hold position to energize load without timing. Hold must be manually terminated. Timer switch shall be surface mounted.

3.2 Electric heaters of types and characteristics as indicated shall be provided.

3.2.1 Unit heaters shall be of the forced convection type securely fastened to wall or ceiling in an approved manner. Heaters shall consist of fan, heating elements, and housing. Housing shall be reinforced steel fitted with adjustable louvers to permit directing the heated air where desired. All ferrous parts shall be treated to prevent rusting before application of a baked-enamel finish. Heating elements shall consist of helically coiled nickel-chromium resistance wire embedded in an electrical-insulating powder within a metal sheath. Castings, if used, shall be free from defects of any nature. Hotspot temperature shall not exceed 750 degrees Fahrenheit. A propeller fan with balanced quiet-operating bladed of corrosion-resistant metal or treated steel shall be mounted on the motor. The motor shall be the totally enclosed, split-phase, induction type, and shall have sleeve bearings with lubrication facilities sufficient for an operating period of at least six months. Motor speed shall not exceed 1,800 revolutions per minute. A manually reset thermal cutout shall be provided to shut off the electric supply automatically in the event of overheating. The heater shall be automatically controlled by a thermostat.

3.2.2 Convectector-type heaters shall consist of a helically coiled nickel-chromium resistance wire embedded in an electric insulating powder within a metal sheath. Heating strips shall be mounted within a ventilated metal housing that will permit a natural flow of air around the heater strips. Heaters shall be securely fastened to the wall and shall be automatically controlled by a thermostat.

3.2.3 Thermostats for electric heaters shall have an approximate range of from 40 to 75 degrees Fahrenheit and an operating differential of three degrees Fahrenheit or less. Temperature setting shall be capable of being locked in a fixed position by a concealed locking device. Thermostat shall be enclosed in a metal case and shall have an indicating thermometer. Thermostat may control the load directly if of adequate rating; otherwise, a separate magnetic contactor shall be used. Control shall open all ungrounded conductors. Thermostats on exterior walls shall be mounted on a base of one-half inch thick plywood.

4. ELECTRICAL:

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4.1 Motors and Controllers: Furnish with their respective pieces of equipment and shall conform to and shall have all electrical connections provided under Section "Interior Electrical Systems"; and shall be provided with maximum of 120 volt control holding circuits. The cost of providing additional electrical service and related work shall be included under this section when motors and equipment furnished are larger than sizes indicated.

4.2 Electrical Work: Is specified in the Section: "Interior Electrical Systems", except for control wiring. Control wiring shall be provided under this section and shall conform to NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except EMT conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

5. SHEET METAL DUCTWORK: Provide in a neat workmanlike manner. Ducts shall be constructed of zinc coated sheet steel conforming to ASTM A525 coating designation G90, except as specified otherwise. Ducts and accessories shall be constructed, braced, reinforced and installed in accordance with NFPA 90A, SMACNA duct construction standards, and ASHRAE equipment handbook. Maximum spacing between hangers shall be 8 feet. Duct supports shall be not less than 0.12 inch by one inch zinc-coated flat bar, except duct supports for ducts less than 18 inches may be No. 16 US gage by one inch zinc coated steel. Lap joints shall be made in the direction of flow. Curved elbows shall have a center line radius not less than 1.5 times the width of the duct. Ducts shall be true to the dimensions indicated, and shall be straight and smooth on the inside with neatly finished air-tight joints. The ducts shall be securely anchored into the building construction in an approved manner and shall be completely free from fibration under all conditions of operation.

5.1 Flexible Duct-Connectors: Provide at all duct connections to each exhaust fan and ventilating fan where indicated. All connectors shall be supported at each end by metal angle frame bands, securely bolted in place as to be air-tight. Duct connectors shall be not less than 20-ounce glass fabric coated both sides with neoprene.

6. CONTROL SYSTEMS:

6.1 Hand-Off-Automatic (H-O-A) switches shall conform to the requirements of the section entitled "Interior Electrical Systems".

6.2 Ventilation Control Systems:

6.2.1 Ventilation systems shall have the following operating conditions based on the settling of the H-O-A switch.

(a) "AUTO" position shall operate the fan when the time intervals have been programmed in the 24-hour programmable time clock.

(b) "HAND" position shall operate the fan regardless of the time clock settings.

(c) "OFF" position, the fan shall not run but the time clock shall continue to operate.

6.3 Electric unit heaters shall be controlled by thermostat.

7. ADJUSTMENTS. All equipment shall be adjusted so that it will perform as specified and as required to give satisfactory operation.

8. CLEANING. All equipment shall be cleaned thoroughly and in accordance with the best orifice.

9. IDENTIFICATION TAGS AND PLATES: All equipment shall be provided with tags numbered and stamped for their usage. Plates and tags shall be of brass or suitable nonferrous material and shall be securely mounted or attached.

10. FIELD TESTS. Upon completion and before final acceptance of the work, each system shall be tested as in service to determine compliance with the contract requirements. All equipment shall be tested in operation for a continuous period of not less than eight hours. During the tests, all equipment shall be tested under every condition of operation. All controls shall be tested through every cycle of operation. The Contractor shall furnish instruments, electricity, connecting devices and personnel for the tests. All defects in the work provided by the Contractor shall be corrected by him at his own expense and the test repeated until proved satisfactory. Each system shall be completely tested for compliance with specification and all conditions thereof.

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SECTION 16011. GENERAL REQUIREMENTS, ELECTRICAL

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

1.1 Federal Specifications (Fed. Spec.):

TT-E-489F & Am 1 Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces).
TT-P-645 Primer, Paint, Zinc-Chromate, Alkyd Type).

1.2 Military Specifications (Mil. Spec.):

MIL-P-15328C & Am 1 Primer (Wash), Pretreatment Blue (Formula No. 117-B for Metals).

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

B117-73 Salt Spray (Fog) Testing.

1.4 American National Standard Institute (ANSI) Publications:

Z 35.1-1972 Specifications for Accident Prevention Signs.

2. APPLICATION: This section applies to all sections of Division 16 of this project except as specified otherwise in the individual sections.

3. SUBMITTALS: Shop drawings, manufacturer's data and certificates for equipment, materials, finish, and pertinent details for each system shall be submitted and approved before procurement, fabrication or delivery of such items to the job site. Partial submittals are not acceptable and such submittals will be returned without review. Descriptive data shall be annotated to show the specific model, type and size of each item the Contractor proposes to furnish.

3.1 Shop Drawings: The drawings shall be a minimum of 8.5 by 11 inches in size, except as specified otherwise, and shall include plans, elevations, and sections of equipment and control spaces identifying and indicating proposed location, layout, and arrangement of items of equipment, control panels, accessories, one line diagrams, schematic diagrams, elementary diagrams, wiring diagrams, and any other items that must be shown to assure a coordinated installation. Wiring diagrams shall have their terminals identified and shall indicate the internal wiring for each item of equipment and the interconnection between the items. Drawings

also shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If any equipment is disapproved, drawings shall be revised to show acceptable equipment resubmitted.

3.2 Manufacturer's Data: Information shall be submitted for all material and equipment as specified in the individual sections that the Contractor proposes to furnish for accomplishment of the contract work. Submittals for each manufactured item shall be manufacturer's descriptive literature, diagrams, performance and characteristic curves, and catalog cuts, and shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, specification reference, applicable Federal, Military, and Industry publication references and all other information necessary to establish contract compliance.

3.3 Standards Compliance: Where equipment or materials are specified to conform to requirements of the standards of organizations such as Underwriters Laboratories (UL), that use a label or listing as method of indicating compliance, proof of such conformance shall be submitted for approval. The label or listing of the specified organization will be acceptable evidence. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization adequately equipped and competent to perform such services, and approved by the Contracting Officer, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

3.4 Certified Test Reports: Where specified in the individual sections and before delivery of materials and equipment, certified copies of the reports of all tests required in referenced publications shall be submitted for approval. For materials for which certified test reports are not required in the individual sections, the testing requirements in referenced publications for materials will be waived provided the manufacturer submits certificates stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture, and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

3.5 Certificates of Compliance: Where specified in the individual sections, certificates from the manufacturer attesting that materials and equipment to be furnished comply with all requirements of this specification and of the reference publications shall be submitted for approval. The certificate shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certificate should simply state that the product conforms to all requirements specified.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that the following products being furnished for this project conform to all requirements of the project specifications and of the reference publications listed:

MANUFACTURER AND PRODUCT

REFERENCE PUBLICATIONS

John Doe Company
Thermoplastic-Insulated Wire

UL 83-1975 (R JUN 77)

SIGNATURE AND TITLE

4. POSTED OPERATING INSTRUCTIONS: Operating instructions approved by the Contracting Officer shall be provided for each system and each principal piece of equipment for the use of operation and maintenance personnel. The operating instructions shall include wiring and control diagrams showing the complete layout of the entire system, including equipment, devices, and control sequence and shall be framed under glass or in approved laminated plastic and posted where directed by the Contracting Officer; printed or engraved operating instructions for each principal piece of equipment including start up, proper adjustment, operating, lubrication, shut-down, safety-precautions, procedure in the event of equipment failure, and any other necessary items of instruction as recommended by the manufacturer of the unit shall be attached to or posted adjacent to the piece of equipment. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

5. INSTRUCTION TO GOVERNMENT PERSONNEL: When specified in other sections, the Contractor shall furnish, without additional expense to the Government, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of mandays (eight-hours) of instruction furnished shall be as specified in other sections.

6. DELIVERY AND STORAGE: Equipment and materials shall be properly stored and adequately protected and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored, and protected in accordance with the manufacturer's recommendations

and as approved by the Contracting Officer. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Plastic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Damaged or defective items, in the opinion of the Contracting Officer, shall be replaced at no cost to the Government.

7. CATALOGED PRODUCTS: Materials and equipment shall be essentially the cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall essentially duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two or more units of the same class of equipment are required, these units shall, unless otherwise noted, be identical and shall be products of a single manufacturer. Each item of equipment shall have the manufacturer's name and address, and the model and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. Nameplate for electrical apparatus shall conform to NEMA standards.

8. SERVICE INTERRUPTIONS: Where interruption of existing service is necessary, the Contracting Officer shall be notified in writing at least 10 days in advance. The interruption shall not be made unless authorized. The outage shall be as short a duration as possible and will take place at a time that will least interfere with normal station activities. The Government will not be responsible for premium time to perform the work scheduled during the outage. See also paragraph "Scheduling the Work" in Section 01011.

9. WARNING SIGNS: Warning signs for electrical equipment and enclosures shall be provided for the fence, railing, or room enclosing electrical equipment such as substations, transformers, and switchgear having a nominal rating of 500 volts and above; and for the enclosure of metal-enclosed equipment, not so guarded or segregated. Signs shall conform to ANSI Z35.1, shall be of metal, and shall have the legend "DANGER HIGH VOLTAGE" in two lines of letters of nominal 3 inch height. The signs shall be of such number and position as to be readable from all accessible sides, and shall be not more than 30 feet apart.

10. VERIFICATION OF DIMENSIONS: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all dimensions in the field, and to advise the Contracting Officer of any discrepancy before performing any work.

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

12. MECHANICAL REQUIREMENTS: The interconnecting power wiring and conduit, control wiring rated over 120 volts and conduit, the motor-control equipment forming a part of motor-control centers, of switchgear assemblies, and the electrical power circuits are included under this Division. The electrical components of mechanical equipment such as motors, motor starters, control or push-button stations, float- or pressure-switches, solenoid valves, electrical disconnecting (isolating) means, and other devices functioning to control associated mechanical equipment are specified in the appropriate sections covering such work. Interconnecting wiring for components of packaged equipment shall be provided as an integral part of the equipment as specified elsewhere in the appropriate sections covering such work. All other interconnecting wiring shall be provided by the Contractor.

13. COORDINATION: Electrical work shall be coordinated with other trades involved in the construction project. All work shall be carefully laid out in advance coordinating architectural, structural, mechanical, and electrical features of construction.

14. PAINTING OF EQUIPMENT: Equipment painting, both shop and field applied, shall be as specified herein, and provided under the individual sections of this Division. It is desirable that all paint be shop applied; however, if the manufacturer's standards shop painting system does not meet these requirements, field painting shall be provided.

14.1 Field Painting: Aluminum surfaces shall not be painted. Dirt, rust, oil and grease shall be removed by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees Fahrenheit shall be cleaned to bare metal. Coatings shall be applied to clean and dry surfaces only. Where more than one coat of paint is specified, the second coat shall be applied after the preceding coat is thoroughly dry. Damaged painting shall be retouched before applying the succeeding coat. Shop coats shall be lightly sanded before application of field applied coats.

14.1.1 Metal Surfaces Subject to Temperatures Less than 120 Degrees Fahrenheit: Surfaces shall receive: one coat of pretreatment primer conforming to Mil. Spec. MIL-P-15328 applied to a dry film thickness of 0.3 to 0.5 mil; one coat of primer conforming to Fed. Spec. TT-P-645 applied to a minimum dry film thickness of 1.0 mil; and two coats of

enamel conforming to Fed. Spec. TT-E-489, applied to a minimum dry film thickness of 1.0 mil per coat.

14.2 Optional Paint Systems: Manufacturer's standard equipment painting systems may be provided in lieu of the systems specified hereinbefore provided the Contractor submits certification that the painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt spray fog test. Salt spray fog test shall be in accordance with ASTM B117, except that a 20 percent sodium chloride solution shall be used for the salt spray. Immediately after completion of the test, the paint shall show no signs of blistering, wrinkling or cracking; no loss of adhesion, and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory paint system applied on the equipment shall not be less than the film thickness used on the test specimen.

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SECTION 16300. ELECTRICAL DISTRIBUTION, EXTERIOR

1. APPLICABLE DOCUMENTS: The following specifications and standards of the issues listed below (including the amendments, addenda, revisions, and errata designated), but referred to hereinafter by basic designation only, form a part of this specification to the extent required by the references thereto:

1.1 Federal Specifications:

J-C-30A	Cable and Wire, Electrical (Power Fixed Installation).
QQ-W-343D	Wire, Electrical (Uninsulated).
RR-F-621b	Frame, Cover, Grating, and Step, Manhole.
RR-G-661C	Grating Metal, Bar Type, (Floor, Except for Naval Vessels).
SS-S-210A(1)	Sealing Compound, Preformed Plastic, For Expansion Joints and Pipe Joints.
TT-E-489F (Int. AM-1)	Enamel; Alkyd, Gloss (For Exterior and Interior Surfaces).
TT-P-645	Primer, Paint, Zinc Chromate, Alkyd Type.

1.2 Military Specifications:

MIL-B-7883B	Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys.
MIL-C-18480A(3)	Coating Compound, Bituminous Solvent, Coal Tar Base.
MIL-I-15126F(2)	Insulation Tape, Electrical, Pressure Sensitive Adhesive and Pressure Sensitive Thermosetting Adhesive.
MIL-P-15328C(1)	Primer, Pretreatment (Formula No. 117 for Metals).

1.3 LANTDIV Pole Plates (Dated 5-79) Title

16-1-1	Symbol Legend - General Notes
16-1-2	List of Symbols
16-1-3	Method of Showing Symbols
16-1-3	Explanation of Notes Symbols
16-26	Symbols - TF
16-29	Symbols - TTT
16-31	Symbols - U.G. Terminal (0 - 15 KV)
16-35	Conduit Riser

1.4 LANTDIV Underground Plates (Dated 10-77) Title

3 Standard handholes-electrical (for unpaved areas).

1.5 Association of Edison Illuminating Companies Specifications (AEIC):

C2-1977	National Electrical Safety Code.
C29.2 to C29.7 1977	Wet Process Porcelain Insulators.
C80.1-1977	Rigid Steel Conduit, Zinc Coated.
C80.5-1977	Rigid Aluminum Conduit.
L14.184-1965 (R 1971)	Breaking Load and Elongation of Textile Fabrics (ASTM D1682)

1.13 American Concrete Institute (ACI):

ACI-318-71	Building Code Requirement for Reinforced Concrete, including 1974 supplement.
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1.14 American Association of State Highway and Transportation
Officials (AASHTO):

Standard Specifications for Highway Bridges, 1973,
11th Edition.

2. QUALITY CONTROL: All field tests to determine conformance with the specified requirements shall be performed in the presence of the Contractor's Quality Control Representative (CQCR).

3. SUBMITTALS:

3.1 Shop drawings (SD) and catalog data (CD) for the following items shall be approved by the Contractor Quality Control Representative and submitted to the Contracting Officer for record purposes.

3.1.1 For Contracting Officer Approval:

High Voltage Cable (CD)
Manholes and Handholes (CD)

3.1.2 For Contractor Quality Control Representative Approval:

Potheads (CD)	Terminators (CD)
Lightning Arresters (CD)	Fuses (CD)
Cutouts (CD)	Splices (CD)

3.2 Manufacturer's Certifications shall be submitted to the Contracting Officer for the following items:

Conduit, Metal, Flexible	Insulator
Conduit Fittings	Tapes
Wires and Cable, 600 Volt and Less	Ground Rods

05-82-4643

4. GENERAL REQUIREMENTS: General requirements include those specified in Section 16011, General Requirements, Electrical and as specified herein. Prevention of corrosion: Metallic materials shall be protected against corrosion. Outdoor equipment shall be given a rust inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with the earth, and where connected to dissimilar metal, shall be protected by approved fittings and treatment. Steel conduits installed underground shall be coated with an approved asphaltic paint, plastic coating, or shall be wrapped with a single layer of a pressure sensitive plastic tape, half lapped.

5. SERVICE:

5.1 Underground Service: Underground service into buildings shall terminate at a point five feet outside the building and projections thereof. Connections of the underground service to the service switch, panelboard or load center is included in Section: INTERIOR ELECTRICAL SYSTEMS. Ends of the Underground conduit shall be protected by threaded metal caps until connections are made.

5.2 Electrical Characteristics: Electrical characteristics for this project shall be 12.47 KV volts primary, single phase or three phase, 3 wire or 4 wire, 60 hertz and 208, 240 or 460 volts secondary, single phase, or three phase as indicated on the drawings.

6. MATERIALS, EQUIPMENT AND ASSEMBLIES:

6.1 Electrical Tapes: Tapes used for electrical insulation and other purposes in wire and cable splices, terminations, repairs and miscellaneous purposes shall conform to UL 510 and shall be UL approved for the specific application.

6.2 Calking Compound: Compound for the sealing of conduits, ducts, pipes, and sleeves shall be of a putty like consistency workable with the hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. The compound shall readily calk or adhere to clean surfaces of the materials with which it is designed to be used. The compound shall have no injurious effects upon the hands of workmen or upon the materials.

6.3 High Voltage Cable Terminations: Except as otherwise indicated, terminators for solid insulation nonmetallic jacketed cables shall be porcelain insulator type. Terminators shall be applied to single conductor cables or to each conductor of multiple conductor cables, which are exposed to the weather. The terminator and all components shall be the product of one manufacturer and finished in a package or kit form compatible with the insulation and conductor material. The kit shall include complete assembly and installation instructions. Contractor shall supply one complete copy of all manufacturer's instructions and

information. The terminator shall comply with all requirements of IEEE 48 class I except that the requirements of design tightness test need not be met. However, the terminator shall not exude any filler compound under either test or service. The terminator shall consist of a porcelain insulator, cable connector-hoodnut assembly and aerial lug as required, metal body and supporting bracket, sealed cable entrance, and internal stress relief device for shielded cable, and insulating filler compound or material.

6.4 Metal Conduit, Fittings, and Accessories:

6.4.1 Rigid Metal Conduit: Unless indicated or specified otherwise, rigid metal conduit shall be of aluminum, or zinc coated rigid steel. Rigid aluminum conduit shall conform to ANSI C80.5. Rigid steel conduit shall conform to ANSI C80.1. Aluminum conduit shall not be installed underground or encased in concrete and shall not be used with brass or bronze boxes or fittings. Except where indicated or specified otherwise, rigid metal conduit installed underground shall be encased in concrete as specified for underground duct lines. Bushings shall be provided on each end of conduit sleeves which pass through cable vault walls and roofs.

6.4.2 Flexible metal Conduit: Flexible conduit shall conform to UL-1.

6.4.3 Fittings, Boxes, Covers and Outlets: Fittings and accessories for rigid metallic conduit and flexible steel conduit shall conform to UL 467 and UL 514, as applicable and shall meet the following requirements: Fittings, boxes, covers and outlets for use in outdoor work and in exposed indoor work, shall be cast or malleable iron or cast aluminum and shall have threaded hubs. Where used with aluminum conduit in wet locations, they shall be of aluminum alloy containing less than one percent copper. Iron or steel fittings, except bar hangers, shall be cadmium or zinc coated. Junction boxes shall conform to UL 514. Each box shall have the volume required by the National Electrical Code for the number of conductors enclosed in the box and shall meet the requirements of the National Electrical Code for installation of boxes and fittings. Cast metal conduit outlets and entrance caps shall conform to UL 514 and shall be cadmium or zinc coated if of ferrous metal.

6.4.4 Exposed Conduits: All exposed conduits, including pole risers and elbows for stub ups shall be hot dipped galvanized rigid steel conduit.

6.5 Plastic Conduit: Plastic conduit shall be polyvinyl chloride (PVC) and conform to NEMA TC-8. Use and installation shall be in accordance with the National Electrical Code requirements for the installation of nonmetallic rigid conduit. PVC conduit for direct

burial in earth shall be type DB. PVC conduit for concrete encasement shall be type EB. Couplings shall provide a watertight joint and shall be of the same material as the conduit.

6.6 Wires and Cables: Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils. Unless otherwise noted, conductor and conduit sizes indicated are for copper conductors. Overhead power transmission and primary distribution line conductors shall be as hereinafter specified. Insulated aluminum or copper clad aluminum conductors may be used in lieu of insulated copper conductors only on conductors rated 600 volts or less and in sizes No. 4 AWG and larger. All conductors No. 6 AWG and smaller shall be copper. All grounding conductors shall be copper. If aluminum or copper clad aluminum conductors are used, the conductors shall have equivalent copper conductor current carrying capacity and the conduit sizes shall be increased to provide the maximum conduit fill in accordance with the National Electrical Code. If aluminum conductors are used, Contractor shall use particular care in making up joints and terminations. Surface oxides shall be removed by cleaning with a wire brush or emery cloth. Joint compound shall be used for connecting aluminum to aluminum.

6.6.1 Connectors and Terminals: Connectors and terminals shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on all stranded conductors. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

6.6.2 Underground cabling and equipment shall conform to the respective specifications and other requirements specified herein:

(1) Grounding conductors shall be No. 6 AWG copper for grounding cable sheaths, cable shields, conduit, and equipment and No. 4 AWG copper for grounding lightning arresters to ground rods for ground systems as shown.

(2) Neutral conductors shall have type TW insulation.

(3) Cable for 12.47 KV distribution system shall be cross linked thermosetting polyethylene insulated cable conforming to IPCEA S-66-524, as applicable and AEIC No. CS5. Ozone resistant ethylene propylene rubber insulated cable conforming to IPCEA S-68-516. Cable shall be single conductor, employing concentric, Class B stranded copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal wire type consisting of a concentric serving of wires according to IPCEA S-66-524. Cable shall be rated 15 kv with insulation and jacket thickness of 175 and 80 MILS, respectively. Cable shall have a polyvinyl chloride jacket. Contractor shall be responsible for determining the cable cutting lengths. Lengths shown on the drawings are for estimating purposes only. Conductor size shall be as indicated.

(4) All circuits 600 volts and less, including service entrances, shall be served by type USE cable, rated 600 volts, unless otherwise indicated or specified. Conductors shall be copper. Conductor size and number of conductors in each cable shall be as indicated. Cable shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice or termination is made. Conductor identification shall be by color coded insulation conductors, plastic coated self sticking printed markers, colored nylon cable ties and plates or heat shrink type sleeves. Control circuit terminations shall be properly identified.

Colors to be used in coding shall be:

208 VOLT SYSTEM

Neutral - White
Phase A - Black
Phase B - Red
Phase C - Blue
Grounding Conductor - Green

480 VOLT SYSTEM

Neutral - White
Phase A - Brown
Phase B - Orange
Phase C - Yellow
Grounding Conductor - Green

6.6.3 Base copper wire for grounding, bonding, and other uses, when not specified otherwise, shall conform to specification QQ-W-343.

6.6.4 Secondary line and service wires and cables of the weather resistant, insulator supported type shall be polyethylene covered and shall conform to Specification J-C-145. Service entrance and service drop wires and cables shall conform to Specification J-C-30.

6.6.5 Control cables for remote control of power and lighting equipment shall have a rating of not less than 600 volts, and shall conform to the IPCEA Standards publication No. S-19-81, S-61-402, S-66-524.

6.6.6 Wires and cables for locations and uses not specified above shall be suitable for the purpose and in accordance with the National Electrical Code.

6.7 Ground Rods:

6.7.1 Copper Class Steel Ground Rods: Rods shall be rolled to a commercially round shape from a welded copper clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have a tensile strength of 65,000 pounds per square inch (psi). The rods shall be not less than 3/4 inch in diameter by 10 feet in length and shall have a hard, clean, smooth, continuous copper surface and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.013 inch at any point on the rod.

Each ground rod shall be die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in feet.

6.8 Lightning Arresters: Distribution valve type 15 kv arresters shall conform to NEMA LA-1, shall be designed for outdoor service, and shall be equipped with suitable mounting brackets for the applicable method of mounting.

6.9 Primary fuse cutouts shall be heavy duty, open type, rated 15 kv. Open link rural type cutouts are not acceptable. Fuse ratings shall be equal to approximately 150 percent of the transformer full load rating, or shall be as indicated on the drawings and coordinated to the transformers provided. Cutouts and fuse links shall conform to NEMA No. SG-2.

6.10 Materials for Handholes:

6.10.1 Concrete shall be as specified in section entitled "Cast-In-Place Concrete".

6.10.2 Brick: Brick used where indicated shall be sewer and manhole brick conforming to ASTM C-32, grade MS.

6.10.3 Mortar: Mortar shall be mixed in proportions of 1-part portland cement, 1/4-part hydrated lime and between 2-1/4 and 3-parts sand by volume.

6.10.4 Metal Frames, Covers and Gratings: Frames, covers and gratings, except as indicated or specified otherwise, shall conform to specification RR-F-621 and shall be of cast iron. Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled steel floor plate having an approved anti-slip surface. Steel gratings shall be of welded construction and conform to the applicable requirements of Specification RR-G-661, Type I. Hinges shall be of wrought steel, 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have fast pins and five knuckles. The surface of plates under hinges shall be true after the removal, by grinding or other approved method, of raised lugs.

6.10.5 Pulling-In Irons: Pulling-in irons shall be steel bars bent in the form indicated, and cast in the walls and floors. In the floor they shall be centered under the handhole cover, and in walls they shall be not less than 6 inches above or below, and opposite the conduits entering the handhole. Pulling-in irons shall project into the handhole approximately 4 inches. Irons shall be zinc-coated after fabrication.

6.10.6 Cable Racks: Cable racks, including cable rack arms and insulators, shall be sufficient to accommodate the cables. Racks shall be spaced not more than 3 feet apart and each handhole wall shall be

provided with a minimum of 2 racks. The wall bracket shall be 4 inches by approximately 1-1/2 inch x 3/16 inch x 48 inches long (minimum) channel steel. Slots for mounting cable rack arms shall be spaced at 8 inch intervals. The cable rack arms shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be zinc-coated after fabrication.

6.10.7 Fiberglass Handholes: Handholes shall be matched die molded of dark green fiberglass with approximate dimensions of 32 inches high, top surface of 43 inches x 37-1/2 inches and top opening of 32 inches x 26 inches. When buried the unit shall be capable of supporting an ultimate downward load of 7,000 pounds distributed over a 6 inch x 6 inch area imposed anywhere on the cover surface. Unit shall have pre-cut 6 inch x 6 inch cable entrance at the center bottom of each side. A fiberglass weatherproof cover with non-skid surface shall be provided for each handhole. Covers shall be capable of being locked into position.

6.11 Transformers, switchgear, and substations shall be as specified in section: 16335 - TRANSFORMERS, EXTERIOR.

7. INSTALLATION:

7.1 General Requirements: Electrical installations shall conform to the National Electrical Safety Code, the National Electrical Code, and to the requirements specified herein.

7.2 Installation of Underground Systems:

7.2.1 Cables buried directly in earth: The cables shall be buried directly in earth in trenches, except that under railroad tracks, paved areas, and roadways the cables shall be installed in conduit encased in concrete and installed as specified for underground duct lines encased in concrete. Ducts shall have adequate drainage. Trenches in which the cables are placed shall be excavated by hand or with mechanical trenching equipment, shall have a minimum depth of 24 inches below grade shall be not less than 6 inches wide, and shall be in straight lines between cable connections except as otherwise necessary. Cable plows shall be used only when specified. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, they shall be spaced laterally not less than 3 inches apart. When rock is encountered, it shall be removed to a depth of not less than 3 inches below the cables' depth and the space filled with sand or clean earth free from particles that would be retained on a 1/2-inch sieve. Cables shall be unreeled in place at the bottom of the trench; they shall not be unreeled and pulled into the trench from one end. Cables crossing other cables or metal piping shall be separated from the other cables or pipe by not less than 3 inches of well tamped earth. Bends in cables shall have an inner radius of not less than 12 times the cable diameter. Horizontal slack of approximately 3 feet

shall be left in the ground on each end of cable runs, on each side of connection boxes, and at all points where connections are brought above ground. Where cable is brought above ground, additional slack shall be left to make necessary connections.

7.2.2 Soil poisoning of direct burial cable trenches:

(1) One of the following insecticides, prepared as an emulsion with water in the concentration indicated, shall be used for soil poisoning treatment of direct burial cable trenches:

- a. Aldrin, 0.5 percent
- b. Chlordane, 1.0 percent
- c. Dieldrin, 0.5 percent
- d. Heptachlor, 0.5 percent

(2) The soil poison treatment shall be applied in accordance with precautions on the insecticide label and in the following manner:

a. The insecticide water emulsion shall be applied uniformly to the bottom of the trench, immediately prior to laying the cable, at a rate of one gallon per five linear feet of the trench.

b. After laying the cable and overlaying with the first layer of earth or sand as hereinafter specified, apply the insecticide uniformly at a rate of 2 gallons per five linear feet of the trench prior to compacting the earth or sand. After the insecticide application fill the trench and recondition the surface as required.

7.2.3 Pulling lengths. Pulling lengths shall be determined by the Contractor. Cable rated 4.16 KV and above shall be cut to pulling lengths, pulling eyes attached, and sealed by manufacturer. Pulling tension shall not exceed cable manufacturer's recommendations.

7.2.4 Identification: Each cable shall be identified by corrosion resistant embossed metal tags (attached in each handhole) in accordance with the cable schedule, and as approved by the Contracting Officer. Example: 12.47 KV cable, Circuit 4-Sub. NB - to SP.

7.2.5 Expansion Bends: All cables shall be installed with expansion bends carefully formed in each handhole by training cables around the longest perimeter of the handhole on racks. Bending radius for cables 15KV and below shall not be less than 8 cable diameters. Splices shall be located in such a manner that cyclic bending cannot occur in the spliced sheathed.

7.2.6 Underground Conduit for Service Feeders: Underground conduit for service feeders shall be rigid steel from the service equipment to a point five feet beyond the building and projections thereof and, when not extended beyond this point, the ends of the conduit shall be protected by threaded metal caps; the threads shall be coated with graphite grease or other suitable coating. The underground portion of the conduit shall be encased in a concrete envelope having a wall thickness of not less than three inches and shall be buried as specified for underground ducts encased in concrete. Conduit ends and turnups shall be sealed, to prevent moisture from entering, with calking compound as hereinbefore specified.

7.2.7 Underground Duct Lines Encased in Concrete: Underground duct lines shall be of individual conduits encased in concrete. Except where rigid metallic conduit is indicated or specified, the conduit shall be plastic. Unless indicated or specified otherwise, the kind of conduit used shall not be mixed in any one duct bank and shall be not smaller than 4 inches in diameter, inside. The concrete encasement surrounding the duct bank shall be rectangular in cross-section, having a minimum concrete thickness of 3 inches. Conduits shall be separated by a minimum concrete thickness of 2 inches.

7.2.7.1 The concrete shall be as specified in section: "Cast-In-Place Concrete".

7.2.7.2 The top of the concrete envelope shall be not less than 24 inches below grade and under railroad tracks not less than 36 inches below grade, unless indicated otherwise.

7.2.7.3 Duct lines shall have a continuous slope downward toward handholes and away from buildings with a pitch of not less than 3 inches in 100 feet. Trenches shall be excavated along straight lines, from handhole to handhole, before ducts are laid or handholes constructed so the elevation can be adjusted, if necessary to avoid unseen obstruction. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or close to the end of the run. The long sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with ducts of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

7.2.7.4 Conduits shall terminate in end-bells where duct lines enter handholes. Separators shall be of precast concrete, high impact polystyrene, steel, or any combination of these. The joints of the conduits shall be staggered by rows and layers so as to provide a duct line having the maximum strength. During construction, partially

completed duct lines shall be protected from the entrance of debris such as mud, sand, and dirt by means of suitable conduit plugs. As each section of a duct line is completed from handhole to handhole, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit shall be drawn through each conduit, after which a brush with stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand, or gravel; conduit plugs shall then be immediately installed.

7.2.8 Construction of Handholes:

7.2.8.1 Workmanship: Handholes shall be poured in place or may be of precast construction as specified hereinafter. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Concrete shall be cured by applying 2 coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C309. Handholes shall be standard type 2 according to LANTDIV Underground Plate No. 3. Duct entrances and windows shall be located near the corners of handholes to facilitate cable racking. Covers shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair their strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arrises. Provide all necessary lugs, rabbets and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. The words "electric" shall be cast in the top face of all power handhole covers, respectively.

7.2.8.2 Optional precast concrete construction: In lieu of poured-in-place concrete handholes, the Contractor may, at his option, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

(1) General: Precast concrete handholes shall have the same accessories and facilities as required for poured-in-place handholes. Likewise, they shall have plan area and clear heights not less than those of poured-in-place handholes. Concrete materials and methods of construction shall be the same as for poured-in-place concrete construction, as modified herein. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 pounds per square inch. Handholes may be precast to the design and details shown for poured-in-place construction, precast monolithically and placed as a unit; or, they may be of assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. All structures shall be identified with the manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.

(2) Design for assembled units: Precast structures shall be designed in accordance with the AASHTO "Standard Specifications for Highway Bridges"; concrete and reinforcing shall be designed in accordance with ACI Code 318. Tops and walls of structures shall be designed for AASHTO standard H20 highway loading, with 30 percent loading added for impact, and with design load being that which produces maximum shear and moment. All dead and live loads, as well as impact loading, shall be considered in design. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site, and assuming that the H20 design vehicle will operate on surfaces adjacent to the structure. Ground water level shall be assumed to be three feet below ground surface unless a higher water table is indicated in the boring logs. Design shall also take into consideration stresses induced in handling units. Lifting devices shall be provided for properly handling units. Calculations and shop drawings shall be submitted covering the design and manufacture of precast units, and shall bear the seal of a registered professional engineer.

(3) Joints: Mating edges of precast components shall be provided with tongue and grooved joints. Joints shall be designed to firmly interlock adjoining components and to provide waterproof junctions. Joints shall be sealed watertight using preformed plastic strip conforming to SS-S-210. Sealing material shall be installed in strict accordance with the sealant manufacturer's printed instructions. Provisions shall be made for waterproofing cable entrances into structures, and at handhole covers in the top slab.

(4) Installation: Assembly and installation of precast components shall follow the printed instructions and recommendations of the manufacturer of the units. Precast handholes shall be installed on a level bed of well-compacted gravel or crushed stone, well-graded from the one-inch sieve to the No. 4 sieve. Drain sumps shall be provided for precast structures as required for poured-in-place structures.

7.2.8.3 Methods of Anchoring of Cable Racks shall be as follows:

(1) Method "A": Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in manhole wall with 2 inch protrusion of threaded portion of bolt into handhole. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with white lead immediately prior to installing nuts.

(2) Method "B": Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel"; channel insert shall be cast flush in handhole wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

(3) Method "C": Provide concrete "spot insert" at each anchor bolt location, cast flush in handhole wall. Each insert shall have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with white lead immediately prior to installing bolts.

7.2.8.4 Earth Work: Excavation for handholes shall be to depths indicated and of whatever substance encountered. Excavated materials not required or suitable for backfill shall be wasted on the project site as directed. Provide sheeting and shoring as necessary for protection of work and safety of personnel. Remove water from excavation by pumping or other approved method. Backfilling around structures shall consist of earth, loam, sand-clay, or sand and gravel, free from large clods of earth or stones over 1-inch in size. Approved backfill materials shall be placed symmetrically on all sides in loose layers not more than 9-inches deep. Each layer shall be moistened, if necessary, and compacted with mechanical or hand tampers.

7.2.8.5 Field Painting: After installation, cast-steel frames, covers and gratings not buried in masonry shall be cleaned to the bare metal of mortar, rust, grease, dirt and other deleterious materials and given a coat of bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly clean. Immediately after cleaning, surfaces shall be coated with a coat of pretreatment coating conforming to Specification MIL-P-15328. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be primed with a coat of zinc chromate primer conforming to Specification TT-P-645 and one coat of synthetic gloss enamel conforming to Specification TT-E-489.

7.2.9 Fireproofing of Cables in Handholes: All wire and cables which will carry current at 2200 volts and above in handholes shall be fireproofed (arc-proofed) as hereinafter specified.

(1) Procedure: Strips of fireproofing (arc-proofing) tape approximately 1/16 inch thick by 3 inches wide shall be wrapped tightly around each cable spirally in one half-lapped wrapping, or in two butt-jointed wrappings with the second wrapping covering the joints in the first. The tape shall be applied with the coated side toward the cable and shall extend one inch into the ducts. To prevent unraveling, the fireproofing (arc-proofing) tape shall be random wrapped with tape conforming to type GFT of Specification MIL-I-15126. The fireproofing (arc-proofing) tape shall consist of a flexible, conformable fabric having one side coated with a flame retardant, flexible, polymeric coating and/or a chlorinated elastomer. The tape shall be not less than 0.050 inch thick and shall weigh not less than 2.5 pounds per square

yard. The tape shall be noncorrosive to cable sheath, shall be self-extinguishing, and shall not support combustion. The tape shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus. The tensile strength of the tape shall be not less than 40 pounds per inch width, and when tested under ANSI Standard LI4.184 cut strip method, the tape shall retain 65 percent of its original tensile strength for the following tests for 168 hours for each requirement: (1) Immersion in distilled water, (2) Immersion in 3 percent salt water, (3) Exposure of ultra-violet light (30 watt germicidal lamp), (4) Exposure to sunlight (Type S-1 sun lamp), and (5) Exposure to concentrated sewage. The completed installation of fireproofing (arc-proofing) shall be capable of withstanding a 200-ampere arc for 30 seconds when tested as specified hereinafter.

7.2.10 Identification Slabs (markers): Slab markers shall be provided at each 300 foot interval, at each change of direction and over each splice. Also slab markers shall be provided over the ends of ducts or conduits which are installed under paved areas and roadways. Identification slabs shall be of concrete approximately 20 inches square by 6 inches thick and shall be set flat in the ground so that the top surface projects not less than 3/4 inch, nor more than 1-1/4 inches above ground. The concrete shall have a compressive strength of not less than 2500 psi as hereinbefore specified and have a smooth troweled finish on exposed surface. An identifying legend such as "cable," "duct," "splice," or other applicable designation shall be inscribed on the top surface before the concrete hardens. Circuit identification symbols shall also be inscribed on identification slabs as directed. The letters and/or figures shall be approximately 2 inches high and the grooves shall be approximately 1/4 inch in width and depth. The identification slabs shall be installed so that the nearest side is 12 inches, horizontally, from the cable, splice, conduit, or duct; the inscription on the top shall include an arrow indicating the nearest side.

7.2.11 Backfilling: Backfilling shall be in layers not more than 8 inches deep and shall be thoroughly tamped. The first layer shall be earth or sand, free from particles that would be retained on a 1/4-inch sieve and extending not less than 3 inches above the top of the cables. The succeeding layers shall be excavated material having stones no larger than would pass through a 4-inch ring. The backfill may be moistened. The backfill shall be level with the adjacent surface except that in sodded areas a space equal to the thickness of the sod shall be left.

7.2.12 Reconditioning of Surface: The surface disturbed during the installation of duct or cable shall be restored to its original elevation and condition. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Sod that is damaged shall be replaced by sod of a quality equal to that removed. Where the surface is disturbed in a newly seeded area, the restored surface shall

be re-seeded with the same quantity and formula of seed as that used in the original seeding.

7.2.13 Special conditions: During the construction of all duct lines, or handholes located in streets, the streets must be kept open to traffic. The Contractor shall plan and execute his work to meet this condition. At locations where duct lines cross railroad tracks and the work requires closing of the tracks, the Contractor must secure permission from the Contracting Officer for each tract closure.

7.2.14 Warning Tapes in Earth Trenches: For the purposes of early warning and identification during future trenching or other excavation, continuous identification tapes shall be provided in the trench above all direct buried conduits. Tape shall be non-magnetic plastic tape or aluminum foil plastic backed tape manufactured for the purpose or early warning and identification of utilities buried below the tape. Tape shall be at least three inches in width. Color of tape shall be as standard with the manufacturer with respect to the type of utility buried below the tape. Tape shall have lettering at least one inch high with not less than the following identification on the tape: "BURIED ELECTRIC LINE BELOW". Tape shall be installed in accordance with the printed recommendations of the tape manufacturer, as modified herein. Tapes shall be buried at a depth of 6 inches below the top surface of earth; in pavements this 6 inches shall be measured from the top of the subgrade.

7.3 Installation of Overhead Systems:

7.3.1 Circuit Protective Apparatus: Pole-type lightning arresters and fuses shall be provided on primary lines at all aerial-to-under ground connections, dead ends, reclosers, sectionalizing switches and transformers, and at other locations where indicated. The devices shall be coordinated with the system to which they are connected. Automatic circuit reclosers and automatic line sectionalizers shall be provided where indicated.

7.3.2 Cable Risers on Poles: Cable risers on poles, other than grounding conductors, shall be installed in conduit. The conduit for cable risers shall be encased in concrete to a point 6 inches above finished grade. The conduit shall be of the rigid metal type as hereinbefore specified. Conduit shall be secured to the pole by means of suitable clamps or straps spaced not over 4 feet apart.

7.4 Splices in Wires and Cables: All splices shall be in accessible locations. Tapes shall be as specified hereinbefore. Metallic shield or armor, where used, shall be made continuous by soldering or brazing the same kind of metal to the original shield or armor on each side of the splice. In handholes, splices in shielded cable shall include a shield ground connection brought out through the jacket in a watertight manner; this connection shall be grounded in the installation of the

splice. Cable splices in handholes shall be supported by racks on each side of the splice. Cables shall be installed at middle and bottom of cable racks leaving top space open for future cables. One spare 3-insulator rack arm shall be provided for each cable rack in each handhole. The Contractor shall use particular care in making up joints and terminations in aluminum conductors. Surface oxides shall be removed by cleaning with a wire brush or emery cloth. Joint compound shall be used on conductors and U.L. listed solid aluminum connectors shall be used for connecting aluminum to aluminum. When connecting aluminum to copper, connectors specifically designed for this purpose shall be used. Splices in insulated power and lighting cables for service exceeding 600 volts shall be made by splicers having not less than three years experience in splicing such cables; the Contractor shall furnish satisfactory evidence of such experience as specified hereinbefore.

7.4.1 Splices in Insulated Power and Lighting Wires and Cables Without Metallic Sheath: Conductors shall be jointed securely both mechanically and electrically by one of the following methods: (1) twisting the conductors together and soldering, (2) twisting the conductors and forming a "Western Union" joint, (3) Exothermic weld process, or (4) by the use of solderless connectors. Insulating tapes, hotmolded composition covers, or their approved equivalent, having an insulation value equivalent to the conductor insulation may be used for splices in cables rated 600 volts and below. Splices in rubber- or cross-linked polyethylene-insulated, neoprene- or cross-linked polyethylene-jacketed wires and cables shall be the cast type, watertight taped type, tape-overcast type, vulcanized type, or other approved type as indicated or specified. The work shall be in accordance with the recommendations of the manufacturer of the wires, cables, and/or splicing materials. All splices shall be suitable for the rated insulation level of the cable.

(1) Epoxy cast-type splice: The insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material. The resin material shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing without removing from the package. The gravity poured method shall not be used for splices in shielded cable.

(2) Watertight Taped Type Splice: The splice shall consist of an approved connector, self-fusing tape (splicing compound), self-bonding semi-conducting tape, tinned copper shielding tape or braid, and plastic tape.

(3) Tape-Overcast Type Splice: This splice shall be as specified hereinbefore for the watertight taped type, overcast with an epoxy resin construction as specified hereinbefore for the cast type, pressure method. This splice shall be suitable for the rated voltage of the cable, to a limit of 15 kv.

7.4.2 Splices in Overhead Line Conductors: Splices in overhead line conductors shall be made with twist sleeve or compression type connectors. Splices in insulated conductors shall be covered with an insulation equivalent to that of the conductors and an approved weatherproof tape overall.

7.4.3 Grounding of Shields in Splices of Power Cables: In handholes the splicing of shielded power cables shall include the grounding of the shielding tape. Wires connecting the shields to the ground rod shall be trained toward the sides in such manner as not to be in the way of maintenance personnel.

7.5 Termination of Insulated Power and Lighting Cables: All insulated power and lighting cables shall be properly terminated. Terminations shall be made by adequately trained personnel, using methods and materials suitable for the work as necessary and as specified hereinafter, and in accordance with the recommendations of the manufacturer of the cable and/or terminating materials or kit. Such recommendations, accompanied by suitable detail drawings, shall be submitted to the Contracting Officer for approval. Terminations of cable for service exceeding 600 volts shall be made by personnel having not less than 3 years experience as a licensed electrician, including adequate experience in the splicing or terminating of high-voltage insulated cable; the experience shall be certified and approved by the Contracting Officer. Terminations and/or terminating devices shall be capable of withstanding the tests specified for the cable installations, and for service exceeding 600 volts, shall be rated in accordance with, and be capable of withstanding test voltages in accordance with IEEE standard No. 48, as applicable. Terminations of single- and multi-conductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Cables and cable terminations shall be adequately supported so as to avoid any excessive strain on the termination and the conductor connection.

7.6 Protection of Wire and Cable Ends: The ends of wires and cables in handholes and in other wet location as defined by the National Electrical Code that are not to be spliced or connected to equipment shall be protected from moisture and other damage by line end caps suitable for the rated insulation level of the cable.

7.7 Grounding: Grounding shall be in accordance with the National Electrical Code and the National Electrical Safety Code except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding the following values:

	<u>Ohms</u>
For grounding pad mounted transformers without protective fences.	5
For grounds in handholes.	10
For grounding other metal enclosures of primary voltage electrical and electrically operated equipment.	10
For lighting arrester grounds on pole line distribution systems.	10
For grounding secondary distribution systems (neutral) non-current carrying metal parts associated with distribution systems.	25
For grounds not covered above.	25

When work in addition to that indicated and specified is directed, in order to obtain the specified resistance to ground, the provisions of the contract respecting an adjustment for changed conditions shall apply.

7.7.1 Ground Rods: Approved copper-alloy clamp shall be brazed to the upper end of ground rods, and ground wires shall be securely attached thereto by means of a bolted connection. Ground rods shall be driven to a depth of not less than 11 feet and shall have diameters sufficient to permit driving to necessary depth without being damaged, but in no case shall the diameter be less than hereinbefore specified.

7.7.2 Welded or Brazed Connections: Joints in grounding conductors and mats shall be welded or brazed. The welding or brazing processes shall not in any way cause the parts joined to be damaged or weakened and shall join all strands. The welding process shall be an exothermic type, and the completed connection or joint shall be equal or larger in size than the conductors joined. The brazing process shall be in accordance with MIL-B-7883.

7.7.3 Ground Cable Crossing Expansion Joints: Ground cables crossing expansion joints or similar separations in structures and pavements shall be protected from damage by means of suitable approved devices or methods of installation which will provide the necessary slack in the cable across the joint to permit movement. Stranded or other approved flexible copper cable run or jumper shall be used across such separations.

7.7.4 Grounding and Bonding Equipment: Grounding and bonding equipment, except as indicated or specified otherwise, shall conform to UL publication No. 467.

7.8 Installation of Transformers, Switchgear and Substations shall be as indicated and specified in section: 16335 "Transformers".

8. FIELD TESTS: The Contractor shall provide all labor, equipment and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material and workmanship disclosed as the result of the tests given herein shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.

8.1 Insulation resistance test for systems 600 volts and less: After all wiring is completed and connected ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed, insulation resistance tests shall be made in all feeder and subfeeder circuits. The insulation resistance between conductors and between each conductor and ground shall be measured. Measurements shall be made with an instrument capable of making measurements at an applied potential of 500 volts. Readings shall be taken after the voltage has been applied for a minimum of one minute. The minimum insulation resistance for circuits of No. 12 AWG conductors shall be 1,000,000 ohms. For circuits of No. 10 AWG or larger conductors, a resistance based on the allowable ampacity of the conductor as fixed by NFPA 70 shall be as follows:

25 through 50 amperes.....	250,000 ohms
51 through 100 amperes.....	100,000 ohms
101 through 200 amperes.....	50,000 ohms
201 through 400 amperes.....	25,000 ohms
401 through 800 amperes.....	12,000 ohms
Over 800 amperes.....	5,000 ohms

8.2 High voltage cable tests: After installation and before placing in service, cables shall be given a field acceptance test performed by a representative of the Contractor. Prior to testing, the cables shall be disconnected from all equipment. The test procedure shall be in accordance with AEIC and/or IPCEA. Field acceptance test voltage shall be 56 KILOVOLTS (DC) for 15 minutes. Subsequent acceptance tests, required because of failure of cable to pass the initial test, will be performed at the Contractor's expense.

8.3 Arc-Proofing Test: The capability of fireproofing (arc-proofing) of withstanding a 200-ampere arc for 30 seconds shall be determined by tests made on a sample assembly consisting of a 3-inch diameter lead

tube fireproofed (arc-proofed) as specified hereinbefore. The lead tube shall have a wall thickness of 1/8 inch. The sample assembly shall be tested at three different points. At each point the testing shall consist of an arc current magnetically blown against the test assembly until melting occurs at the point of arc contact. The arc shall be struck between two 7/8-inch electrodes located one inch from the sample assemble. (Note: The electrodes must be squared off after each test run. Failure to do this will result in a weak arc which will extinguish easily.) The arc current shall be between 195 and 210 amperes at 40 volts DC. For each of the three tests, the fireproofing (arc-proofing) shall prevent the arc current from melting the lead tube for at least 25 seconds at any one point and for an average of 30 seconds for the three points. In lieu of the tests specified herein, manufacturer's certification that his product will successfully meet the requirements of the specification may be submitted to the Contracting Officer for approval.

8.4 Ground Resistance Tests: Grounding system shall be tested to assure continuity and compliance with the requirement that ground resistances not exceed the values hereinbefore specified. Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit in writing to the Contracting Officer, the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground electrode under test isolated from other grounds. Ground resistance shall also be measured for each piece of equipment to the ground electrode.

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SYMBOL LEGEND

A	-----	ANGLE
AB	-----	ANGLE BRACE
D	-----	DOUBLE
DE	-----	DEADEND
F	-----	FLAT (HORIZONTAL)
FB	-----	FLAT BRACE
LP	-----	LINE POST
N	-----	NEUTRAL
R	-----	RIDGE OR POLE TOP PIN
S	-----	SECONDARY, OPEN WIRE
St	-----	SECONDARY, TRIPLEX
SQ	-----	SECONDARY, QUADRUPLX
T	-----	TRANSFORMER
TERM	-----	TERMINAL
UG	-----	UNDERGROUND
V	-----	VERTICAL
X	-----	CROSSARM, 8'
X10	-----	CROSSARM, 10'

GENERAL NOTES:

1. Symbols comprising the Lantdiv Pole Plates are not intended to be "all inclusive" for use on every distribution pole line configuration. Only plates which reflect typical arrangements are included. For other desired arrangements, pole plates should be modified or separate details drawn to reflect the specific conditions.
2. Each pole plate contains material items which comprise a part of each individual symbol referenced by that plate. These items are indicated by circled numerals which are identified by Lantdiv Plate 16-1-5.
3. Spacing requirements related to individual components of a symbol are indicated on the appropriate plate. Vertical spacing requirements between circuits and/or systems are indicated on Lantdiv Plate 16-1-4. All other separations between circuits, equipment, etc., shall conform to the National Electrical Safety Code.. ANSI C2.

SYMBOL LEGEND
GENERAL NOTES

LANTDIV PLATE NO. 16-1-1

DATE: 5/79

LIST OF SYMBOLS

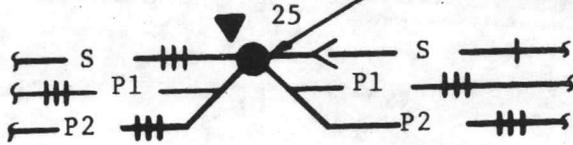
<u>PLATE NUMBER</u>	<u>CATEGORY</u>
16-2 THRU 16-11	CROSSARM SYMBOLS
16-12 THRU 16-15	HORIZONTAL (TANGENT OR ANGLE) CONSTRUCTION SYMBOLS
16-16 THRU 16-19	HORIZONTAL DEADEND CONSTRUCTION SYMBOLS
16-20 THRU 16-23	VERTICAL CONSTRUCTION SYMBOLS
16-24 THRU 16-25	ARMLESS CONSTRUCTION SYMBOLS
16-26 THRU 16-29	TRANSFORMER SYMBOLS
16-30 THRU 16-32	UNDERGROUND TERMINAL SYMBOLS
16-33 THRU 16-34	GUY SYMBOLS
16-35	CONDUIT RISER SYMBOL
16-36 THRU 16-40	SECONDARY SYMBOLS
16-41	GROUND SYMBOL

LIST OF SYMBOLS

LANTDIV PLATE NO. 16-1-2

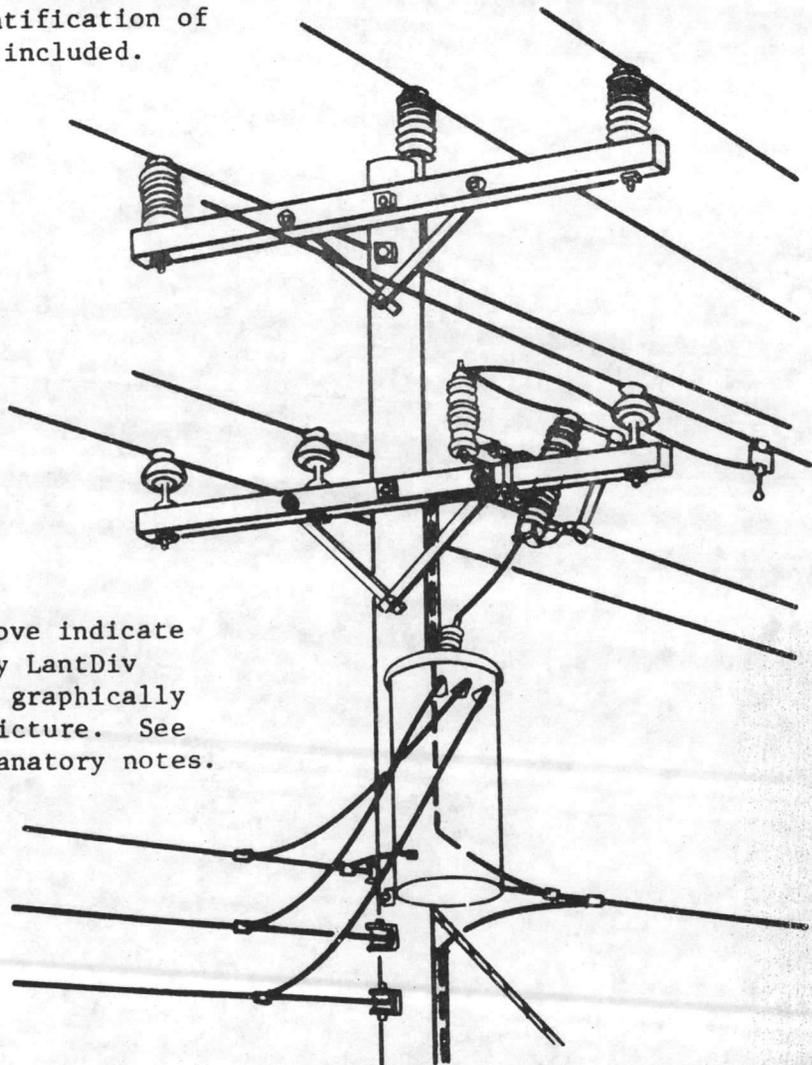
DATE: 5/79

Pole # _____ (45'-3)
 XFB, 35FR3
 XFB, 15F3
 TF (25KVA, 7.6KV - 120/240V)
 S-1, SDE-2
 GUY (5/16")
 ANCHOR (10" Screw)
 GROUND



DESIGN NOTE:

Method of showing information on plan view is optional and shall be coordinated with legend on individual design basis. However, characteristics & identification of all circuits shall be included.



NOTE:

The symbols listed above indicate material (described by LantDiv pole plates) which is graphically illustrated by this picture. See sheet 2 of 2 for explanatory notes.

METHOD OF SHOWING SYMBOLS

LANTDIV PLATE NO. 16-1-3

DATE: 5/79

SHEET 1 OF 2

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EXPLANATORY NOTES - METHOD OF SHOWING SYMBOLS

1. Symbols are shown in the basic order as they appear on the pole, by starting at the top and working down.
2. Numerals preceding the symbol indicate the required voltage rating of the assembly, if applicable.
3. Numeral following the symbol indicates the number of conductor associated with the assembly, if applicable.
4. Numeral in parenthesis following the symbol denotes the number of assemblies required, if more than one.
5. Data in parenthesis following the symbol provides information relative to the symbol.

EXPLANATION OF SYMBOLS LISTED FOR POLE ON SHEET 1 OF 2

Provide 45 foot long, class 3 pole containing:

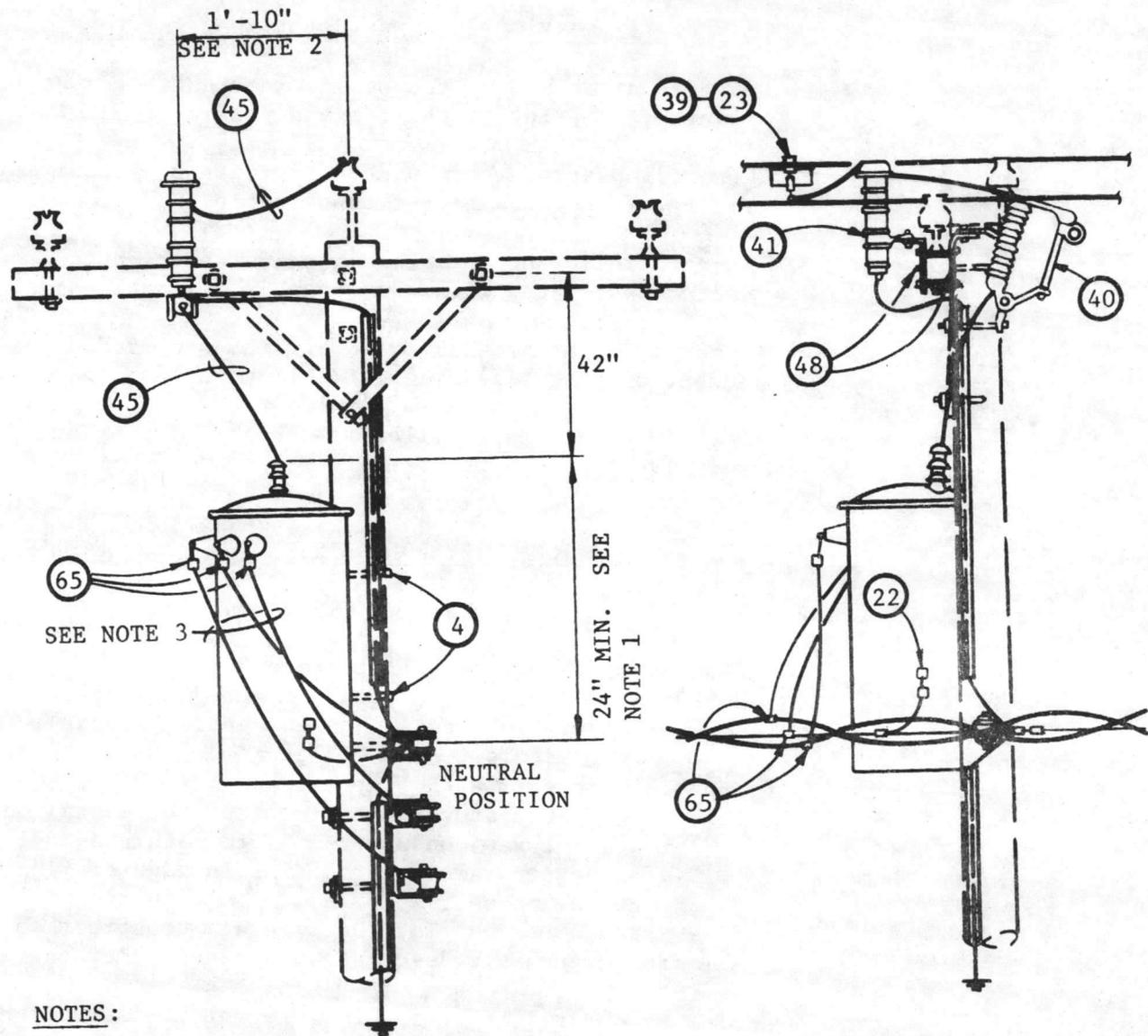
- XFB - 8' crossarm with flat brace
35FR3 - 35KV insulators, flat (mounted horizontal on crossarm),
ridge pin (center phase on pole top pin), three
conductors
- XFB - 8' crossarm with flat brace
15F3 - 15KV insulators, flat (mounted horizontal on cross-
arm), three conductors. Note: this symbol calls for
three crossarm mounted pins in lieu of ridge pin on
center phase.
- TF - transformer on flat (horizontal) construction. Data
in parenthesis describes the transformer characteris-
tics.
- S1 - secondary, one conductor, tangent construction
SDE2 - secondary deadend, two conductors, open wire
GUY (5/16") - down guy - wire size 5/16"
ANCHOR (10" SCREW) - 10" screw type anchor. Note: No plate
is included for the anchor symbol
GROUND - no explanation necessary

EXPLANATION OF NOTES
SYMBOLS

LANTDIV PLATE NO.16-1-3

DATE: 5/79

SHEET 2 OF 2



NOTES:

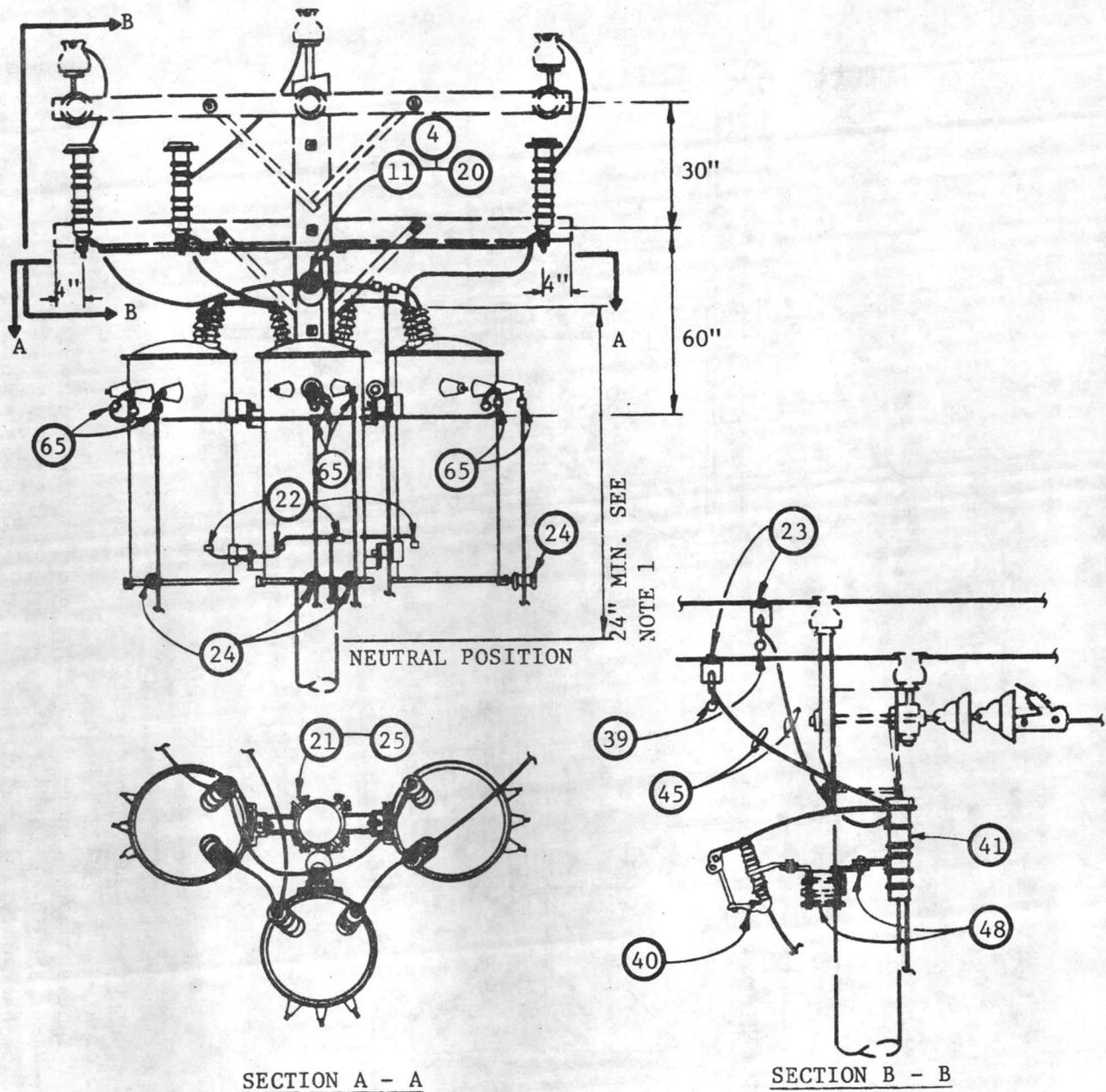
1. This dimension shall be measured on pocket bushing type transformer from lowest energized point on lead or bushing.
2. When transformer is connected to outside phase, this dimension should be changed to 2'-0".
3. When transformer secondary leads connect to open wire or triplex secondary, conductor shall have 600 volt insulation rating and minimum ampacity of 125% of transformer full load secondary current.
4. When transformer provides underground service, size secondary or service conductors as indicated.
5. Modify connections as required to accommodate transformers with primary bushing arrangements other than shown.

SYMBOLS: TF

LANTDIV PLATE NO. 16-26

DATE: 5/79

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NOTES:

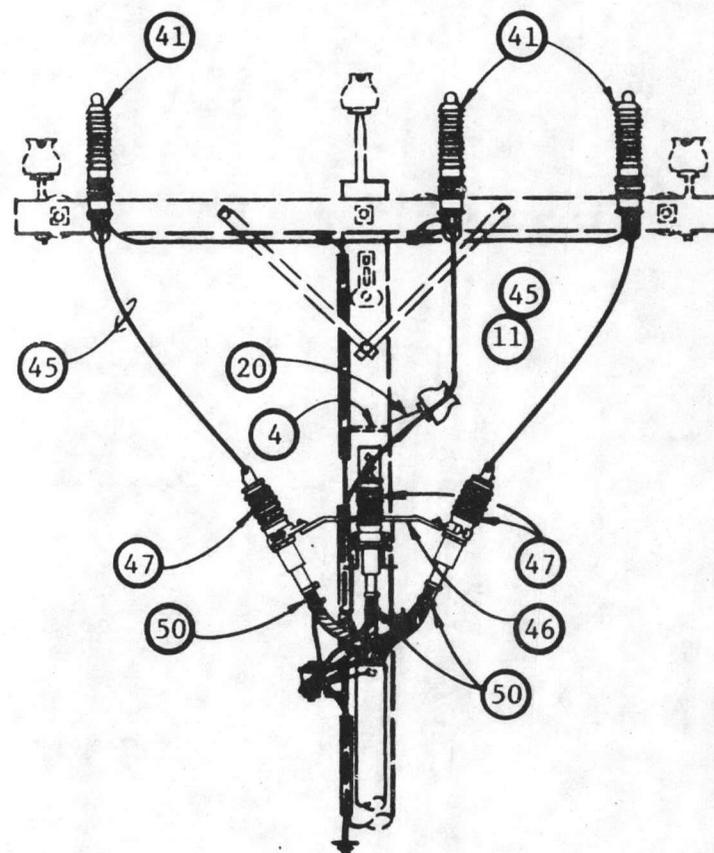
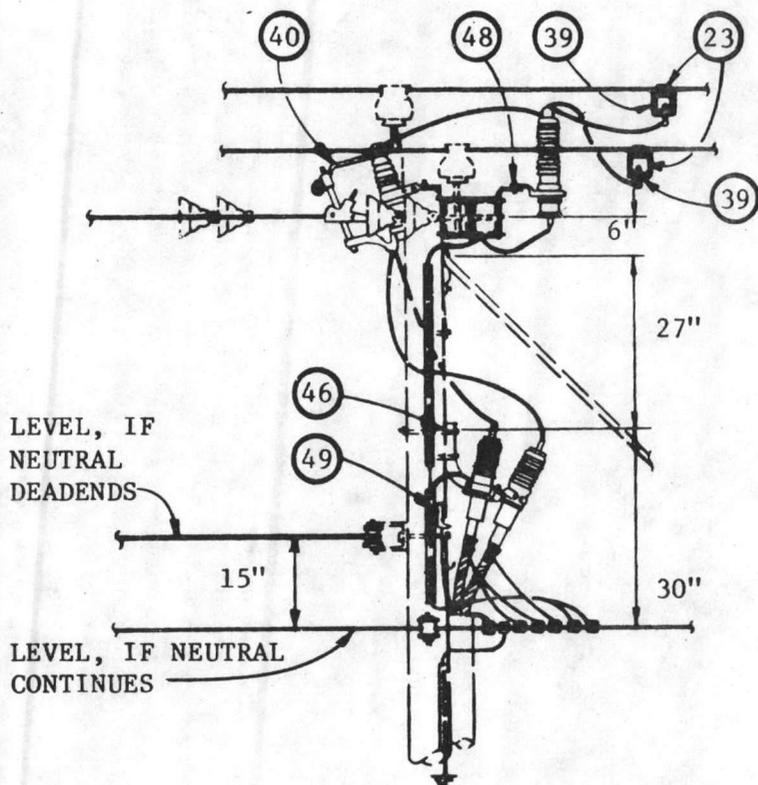
1. This dimension shall be measured on pocket bushing type transformer from lowest energized point on lead or bushing.
2. When transformer secondary leads connect to open wire or quadruplex secondary, conductor shall have 600 volt insulation rating and minimum ampacity of 125% of transformer full load secondary current.
3. When transformer provides underground service, size secondary or service conductors as indicated.
4. Modify connections as required to accommodate transformers with primary bushing arrangements other than shown.

SYMBOLS: TTT

LANTDIV PLATE NO. 16-29

DATE: 5/79

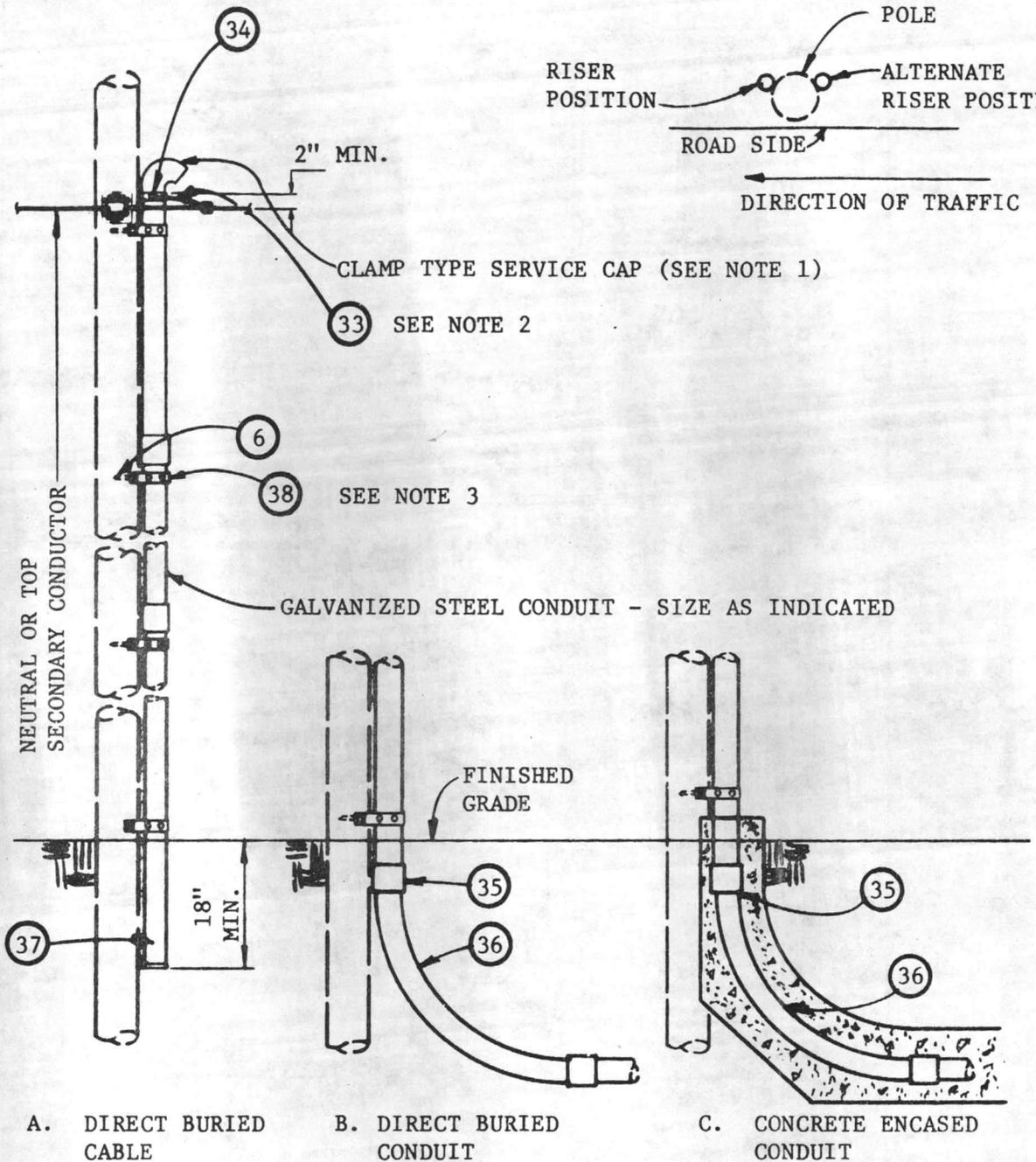
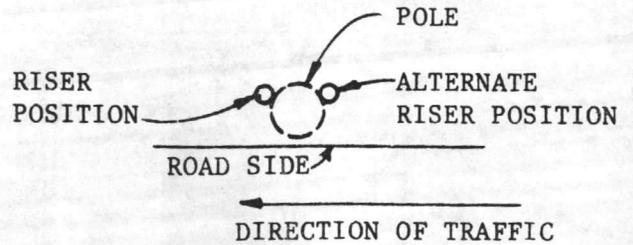
SYMBOLS: U.G. TERMINAL
(0 - 15KV)



NOTES:

1. Position of terminal on deadends is for terminal to be under the conductors and the cutouts on the backside of crossarm. Pole riser must be offset to clear neutral clevis bracket.
2. Lightning arrester lead shall be connected on line side of fused cutouts. Bottom lead of arrester should be connected directly to pole ground.
3. This plate should be used only for radial feeds to individual transformers or other selective applications.

CONDUIT LOCATION



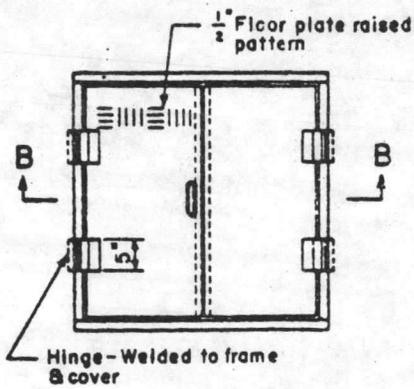
NOTES:

1. On conduit riser for primary circuits, eliminate service cap and provide grounding type insulating bushing.
2. Connect to grounded neutral or provide ground per specifications.
3. Space straps at maximum of 4' intervals.

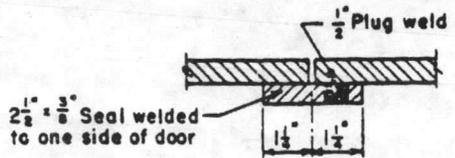
SYMBOLS: CONDUIT RISER
(SIZE AS INDICATED)

LANTDIV PLATE NO. 16-35

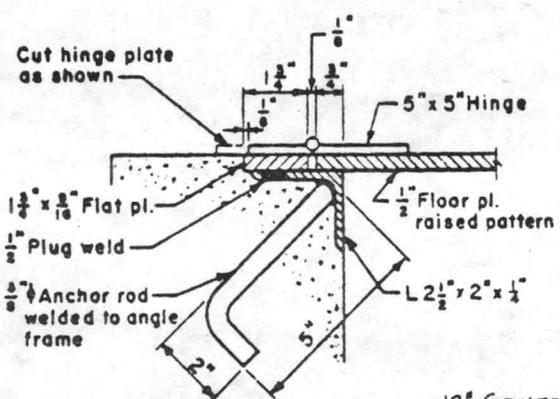
DATE: 5/79



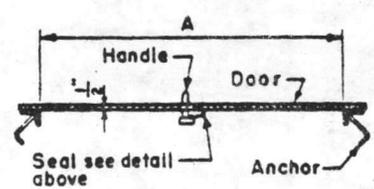
PLAN OF COVER



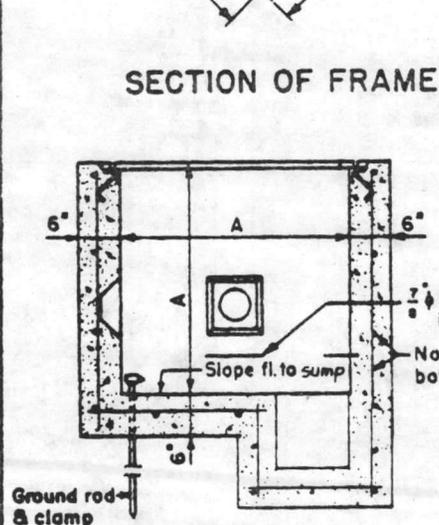
SEAL DETAIL



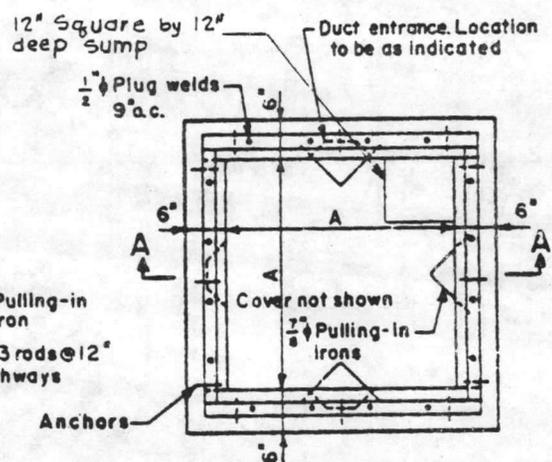
SECTION OF FRAME



SECTION B-B



SECTION A-A



PLAN

HANDHOLE	A
Type 1	3'-0"
Type 2	4'-0"

NOTE: For details of cable racks, duct entrance, and pulling-in Irons see LANTDIV UG PLATE NO. 1

**STANDARD HANDHOLES
ELECTRICAL**

NON-TRAFFIC

For unpaved areas

LANTDIV UNDERGROUND
PLATE NO. 3

SECTION 16335. TRANSFORMERS, EXTERIOR

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

1.1 Federal Specifications (Fed. Spec.):

L-P-387A(1) Plastic Sheet, Laminated, Thermosetting (For
Int Am 2 Designation Plates).

1.2 Military Specifications (Mil. Spec.):

MIL-M-14G Molding Plastics and Molded Plastic Parts,
Thermosetting.
MIL-C-18480A Coating Compound Bituminous Solvent, Coal Tar
& Am 3 Base.

1.3 American National Standards Institute (ANSI) Publications:

C2-1977 National Electrical Safety Code.
C57.12.20-1974 Requirements, for Overhead-Type Distribution
Transformers, 67000 Volts and Below; 500 kVA
and Smaller.
C57.12.25-1975 Pad-Mounted Compartmental-Type Single-Phase
Distribution Transformers with Separable
Insulated High-Voltage Connectors,
High-Voltage, 24940-Grd. Y/14 400 Volts and
Below; Low Voltage, 240/120; 167 kVA and Smaller.
C119.2-1974 Separable Insulated Connectors for Power
Distribution Systems Above 600 Volts.

1.4 American Society for Testing and Materials (ASTM) Publications:

D117-76 Electrical Insulating Oils, Method of Testing.
D3487-79 Mineral Insulating Oil Used in Electrical Apparatus.

1.5 National Electrical Manufacturers Association (NEMA) Publications:

SG 2-76 High voltage Fuses.
TR 1-74 Transformers, Regulators, and Reactors.

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1.6 National Fire Protection Association (NFPA) Publications:

NFPA 70-1978 National Electrical Code.

1.7 Underwriters' Laboratories, Inc. (UL) Publications:

467-1972 Grounding and Bonding Equipment, Electrical
(R NOV 76)

2. FACTORY TESTS:

2.1 Transformer Tests: NEMA TR1, as applicable. Certified copies of test data for the following tests shall be submitted and approval received before delivery of equipment to the project site.

2.1.1 Routine Tests: Routine tests shall be made by the manufacturer on each transformer to insure that the design performance is maintained in production.

2.1.2 Design Tests: Design test reports will be accepted as proof of compliance with design test requirements.

3. SUBMITTALS:

3.1 Materials and Equipment Schedules: As soon as practicable after notice to proceed and before commencement of installation of materials or equipment, a complete list of materials and equipment to be incorporated in the work shall be submitted. List shall include catalog numbers, cuts, diagrams, and such other descriptive data as may be required. No consideration will be given to partial lists submitted from time to time. Approval of materials will be based on manufacturer's published ratings. Materials and equipment listed that are not in accordance with the specification requirements will be rejected.

3.2 Shop Drawings: Shop drawings and catalog cuts for the following items shall be submitted and approval received before delivery of equipment to the project site.

Distribution Transformers
Fuses

Pad-Mounted Transformers
Switches

In addition, the Contractor shall submit the manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuse to allow designer to verify that proper protection and coordination has been achieved.

3.3 Spare Parts Data: As soon as practicable after approval of materials and equipment the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source

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of supply. The foregoing shall not relieve the Contractor of any responsibilities under the guaranty.

3.4 Certificates of Conformance or Compliance: Before delivery of materials, certificates, in triplicate shall be submitted for the following:

3.5 Certified Laboratory Tests Reports: Before delivery of materials, certified copies in triplicate of the reports of all tests required in referenced publications shall be submitted for the following:

Transformers
Switches

Fuses

3.6 Operating and Maintenance Instructions: Instructions for operating and maintenance shall be furnished for the following equipment:

Transformers
Switches

Fuses

4. GENERAL REQUIREMENTS: General requirements include those specified in Section 16011, General Requirements, Electrical and as specified herein. The work includes the provision of a new distribution transformer and pad mounted transformers, for outdoor use. Materials, not normally furnished by the manufacturer with the equipment shall be provided in Section 16300, ELECTRICAL DISTRIBUTION, EXTERIOR. These materials include tapes, terminators, conduit, incoming and outgoing cable, and arresters.

4.1 Insulating liquids:

4.1.1 Mineral Oil: ASTM D3487, Type II tested in accordance with ASTM D1117.

4.2 Insulated Phase Barriers: Mil. Spec. MIL-M-14, type MAT-30.

4.3 Undercoating: Transformers, substations, switchgear, and switchboard which have bases that come in contact with concrete shall have the underside of their bases coated with coal tar base coating conforming to Mil. Spec. MIL-C-18480, 30 mils thick.

5. MATERIALS, EQUIPMENT AND ASSEMBLIES:

5.1 Distribution Transformers (Pole-Type): ANSI C57.12.20 self-cooled, 65 degrees C continuous temperature rise, mineral oil-immersed type. Transformers shall be rated 15 kVA, 95 kV BIL, 15 kV Class for operation on a 12.47 kV delta system. Minimum impedance shall be 1.8 percent. Transformers shall have four 2-1/2 percent rated kVA high voltage taps, 2 above and 2 below rated primary voltage. Tank finish coat shall be light gray, ANSI color No. 70.

5.2 Single Phase Pad-Mounted Transformer: ANSI C57.12.25, shall be provided with insulated high voltage loadbreak connectors and dry-well fuse holder with current limiting fuse shall be constructed of reinforced formed steel sheets no less than No. 12 gage, painted olive green, and shall be delivered fully assembled and ready for operation.

5.2.1 The Terminating Compartment shall be integral with the transformer and shall have the high voltage section on the left facing front and a low voltage section on the right. Compartment shall have a non-conductive, non-hygroscopic full-depth full-height barrier to separate high- and low-voltage apparatus. The door of the terminating compartment shall be of sufficient size to provide adequate working space, and shall be designed for removal and for latching in the open position.

5.2.1.1 The high voltage side shall contain the incoming line, insulated high voltage loadbreak connectors and dry-well fuse holder with current limiting fuse, tap changer, lightning arrester, high voltage bushings, and cable accessory parking stand. The incoming line equipment shall be arranged for radial feed.

5.2.1.2 Insulated high voltage loadbreak connectors: ANSI C119.2 and shall be rated 95 kV BIL, 12.47 kV for operation on a 15 kV system. Current rating shall be 200 amps rms continuous. Loadbreak connectors, inserts and bushings shall be the product of a single manufacturer. Conector shall have a steel reinforced hook-stick eye, grounding eye, and arc-quenching contact material.

5.2.1.3 Current limiting fuse: NEMA SG2, shall be rated approximately 150 percent of the transformer full load rating and shall be mounted in an air-insulated dry-well holder.

5.2.2 The Transformer shall be oil immersed, two winding, 60 HZ, 65 degree C rise above a 30 degree C average ambient, self-cooled type rated 25 kVA, 2.0 percent minimum impedance, 12.47 kV primary 240-volt secondary winding. Transformer shall be provided with four 2-1/2 percent rated kVA high-voltage taps, 2 above and 2 below rated primary voltage. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Basic Insulation Level shall be 95 kV. Accessories shall include rain plug, filler connection, liquid level plug, grounding pads, lifting lugs, provisions for jacking under base and diagramatic nameplate. The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction. The transformer shall have an insulated low voltage neutral bushing with removable ground strap in both primary and secondary compartments with lugs for ground cable. Transformer shall have its kVA rating conspicuously displayed on its enclosure. All devices and connections shall be located on the front of the transformer within the terminating compartment or on top of the transformer under the enclosure roof cover.

6. INSTALLATION:

6.1 General Requirements: Electrical installation shall conform to the National Electrical Safety Code, the National Electrical Code, and to the requirements specified herein. All equipment and materials shall be new unless indicated or specified otherwise.

6.2 Grounding: Grounding shall be in accordance with the National Electrical Code and the National Electrical Safety Code, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding the following values:

For grounding pad mounting transformers without protective fences.	5
For grounds in handholes.	10
For surge arrester grounds on pole line distribution systems.	10
For grounding secondary distribution systems (neutral) noncurrent carrying metal parts associated with distribution systems.	25
For grounds not covered above.	25

When work in addition to that indicated and specified is directed, in order to obtain the specified resistance to ground, the provisions of the contract respecting an adjustment for changed conditions shall apply.

6.2.1 Grounding Electrodes: Where practicable, electrically continuous metallic buried water piping shall be utilized for grounding electrodes. Artificial grounding electrodes shall be the sectional type driven ground rods as specified in Section 16300, Electrical Distribution, Exterior. Approved copper-alloy clamps shall be brazed to the upper end of the ground rods and ground wires shall be securely attached thereto by means of a bolted connection.

6.2.2 Substation Grounding: A bare copper cable not smaller than No. 2/0 AWG shall be provided not less than 24 inches below grade connecting to the indicated ground rods. Where the measured ground resistance exceeds 5 ohms, additional ground rods or deep-driven sectional ground rods shall be provided not less than 6 feet apart, and shall be connected by cable not smaller than No. 4/0 AWG, 2 feet below grade, until a ground resistance of 5 ohms or less is obtained, except that the total length of additional ground rods required shall not exceed 50 feet.

6.2.3 Welded or Brazed Connections: Joints in grounding conductors and mats shall be welded or brazed. The welding or brazing processes

shall not in any way cause the parts joined to be damaged or weakened and shall join all strands. The welding process shall be an exothermic type, and the completed connection or joint shall be equal or larger in size than the conductors joined. The brazing process shall be in accordance with MIL-B-7883.

6.2.4 Ground Cable Crossing Expansion Joints: Ground cables crossing expansion joints or smaller separations in structures and pavements shall be protected from damage by means of suitable approved devices or methods of installation which will provide the necessary slack in the cable across the joint to permit movement. Stranded or other approved flexible copper cable run or jumper shall be used across such separations.

6.2.5 Grounding and Bonding Equipment: UL 467, except as indicated or specified otherwise.

6.3 Installation of Equipment and Assemblies: The installation of distribution transformers and pad mounted transformers furnished under this section shall be installed and connected as indicated on project drawings, the approved shop drawings and as specified herein.

6.3.1 Distribution Transformer Installations shall include one primary fuse cutout and one surge arrester for each ungrounded phase conductor. Cutouts and arresters shall be as specified in section: "Electrical Distribution, Exterior". The kVA rating shall be conspicuously displayed on the transformer tank.

6.4 Foundation for Equipment and Assemblies: Transformer shall be mounted on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6- by 6-inch No. 6 mesh and with a 6-inch thick, well-compacted gravel subbase. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Concrete work shall be as specified in Section 03300, "Cast-In-Place Concrete".

7. FIELD TESTS AND INSPECTIONS:

7.1 General: The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times. The Contractor shall give the Contracting Officer 7 days advance notice of the dates and times for tests and inspections.

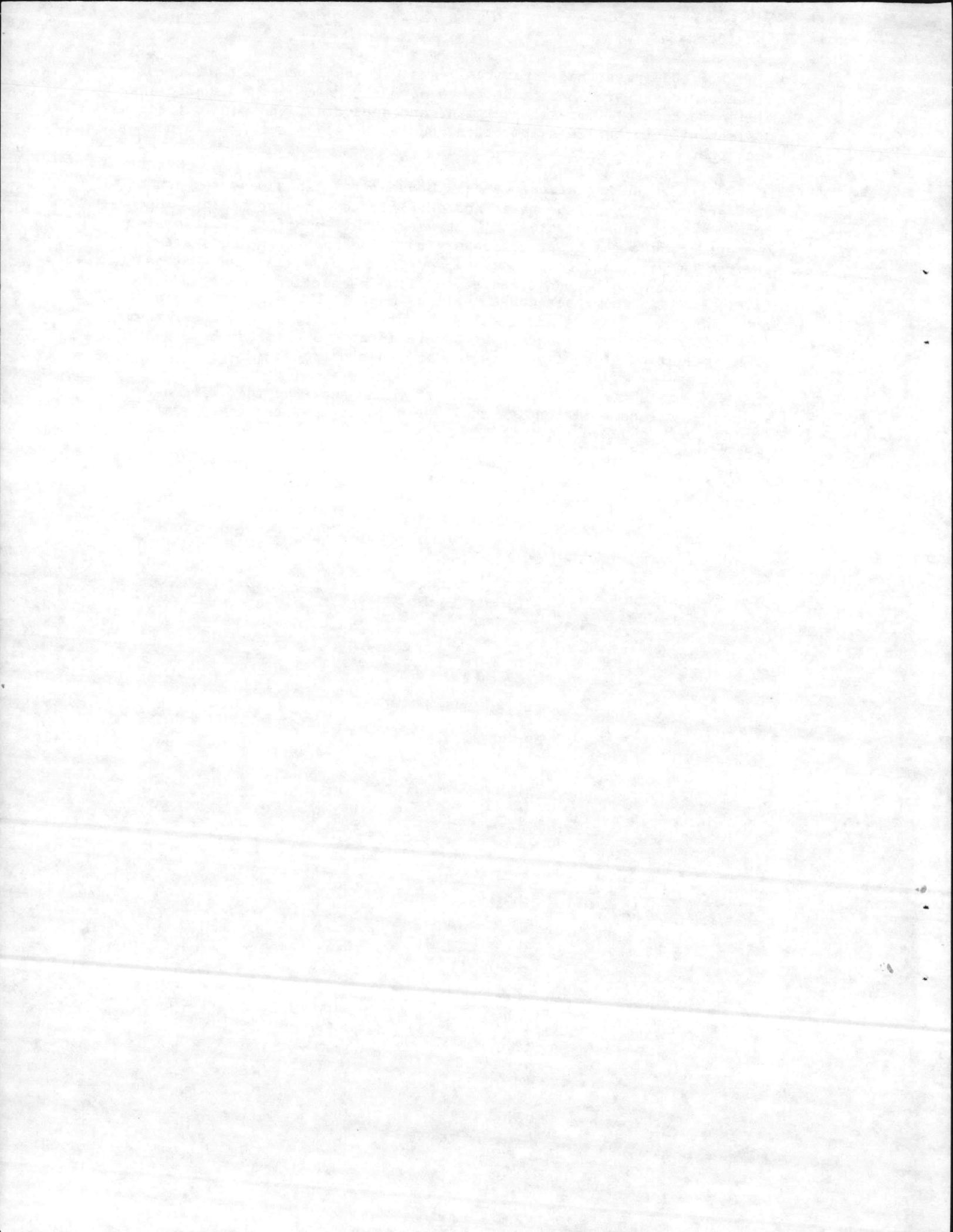
7.2 Tests: After installation, relay setting and coordination tests and dielectric tests shall be performed. Certified copies of the relay settings and dielectric tests shall be provided to the Contracting Officer.

7.3 Equipment and Apparatus Tests: Unless specific factory-witnessed tests are specified, tests normally made by the manufacturer will be acceptable for all equipment and apparatus, and the Contracting Officer will authorize shipment on receipt of satisfactory evidence of such test.

7.4 Ground Resistance Tests: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit in writing the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system, as well as the resistance and soil conditions at the time measurements were made. 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. Ground resistance shall also be measured from each piece of equipment to the ground electrode.

7.5 Retesting: Any deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested at the Contractor's expense.

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SECTION 16402. INTERIOR WIRING SYSTEMS

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

1.1 Federal Specifications (Fed. Spec.):

W-C-375B Circuit Breaker, Molded Case, Branch Circuit and Service.
W-C-596D Connector, Plug, Electrical; Connector, Receptacle, Electrical.

1.2 American National Standards Institute (ANSI) Publications:

C2-1977 National Electrical Safety Code.
C80.1-1977 Rigid Steel Conduit, Zinc Coated.
C80.3-1977 Electrical Metallic Tubing, Zinc Coated.

1.3 National Electrical Manufacturers Association (NEMA) Publications:

KS 1-1975 Enclosed Switches.
ICS 1-1978 General Standards for Industrial Control and Systems
ICS 2-1978 Industrial Control Devices, Controllers and Assemblies
ICS 3-1978 Industrial Systems
ICS 4-1977 Terminal Blocks for Industrial Control Equipment and Systems
ICS 6-1978 Enclosures for Industrial Controls and Systems
MG 1-1978 Motors and Generators
ST 20-1972 Dry Type Transformers for General Applications.

1.4 National Fire Protection Association (NFPA) Publications:

70-1978 National Electrical Code.

1.5 American Society for Testing and Materials (ASTM):

B 1-70 Hard Drawn Copper Wire.
B 8-77 Concentric-Lay Stranded Copper Conductors; Hard, Medium-Hard, or Soft.

1.6 Underwriters' Laboratories, Inc. (UL) Publications:

1-1979 Conduit, Electrical, Flexible Metal.
20-1974 (R DEC 76) Switches, Snap, General-Use.
50-1975 Cabinets and Boxes, Electrical.
(R SEP 76)
67-1974 Panelboards, Electric.
(R SEP 76)

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83-1975	Wires, Thermoplastic-Insulated.
(R JUN 77)	
198.3-1970	Fuses, High-Interrupting-Capacity Class K.
(R OCT 76)	
467-1972	Grounding and Bonding Equipment, Electrical
(R NOV 76)	
486-1976	Wire Connectors and Soldering Lugs.
(R FEB 77)	
510-1976	Tape, Insulating.
514-1974	Outlet Boxes and Fittings, Electrical.
(R JAN 77)	
719-1974	Nonmetallic-Sheathed Cables.
854-1975	Service-Entrance Cables.
(R SEP 76)	
869-1974	Service Equipment, Electrical.
(R FEB 77)	
1242-1977 (DRAFT)	Conduit, Intermediate, Metal.

2. SUBMITTALS:

2.1 Materials and Equipment Schedules: As soon as practicable after notice to proceed and before commencement of installation of materials or equipment, a complete list of materials and equipment to be incorporated in the work shall be submitted to the Contractor Quality Control Representative. List shall include catalog numbers, cuts, diagrams, and such other descriptive data as may be required. No consideration will be given to partial lists submitted from time to time. Approval of materials will be based on manufacturer's published ratings. Materials and equipment listed that are not in accordance with the specification requirements will be rejected.

2.2 Shop Drawings: Shop drawings (SD) and catalog cuts (CC) for the following items shall be submitted to the Contractor Quality Control Representative:

Motor Controllers (CD)	Circuit Breakers (CC)
Disconnect Switches (CC)	Conduit Supports (CC)
Panelboards (SD, CC)	Wireway (SD)
Cable Trough (SD)	Transformers (SD, CC)
Fuses (CC)	Receptacles (CC)
Intermediate Metal Conduit (CC)	

Shop drawing for panelboards, motor control centers, transformers and duct shall include, but shall not be limited to, the following:

- a. Overall dimensions, front view and sectional views, metal gages.
- b. Bus arrangements including dimensions and ampere rating of all bus bars.
- c. Type and spacing of bus supports.

- d. Maximum short circuit bracing.
- e. Circuit breaker type, interrupting rating, trip setting.
- f. Lug size.
- g. Provision for future.

2.3 Certificates: Certificates of Conformance or Compliance are required for the following:

Conduit (except plastic)	Boxes
Toggle Switches	Fittings for cable and conduit
Outlets	Tapes
Ground Rods	Cover and Device Plates
Conductors	

3. GENERAL REQUIREMENTS: General requirements include those specified in Section 16011, General Requirements, Electrical and as specified herein. The work includes the provision of new and the modification of existing interior electrical systems. Each system shall be complete and ready for operation according to the requirements specified herein. The contract drawings indicate the extent and general arrangement of equipment, fixtures, and conduit and wiring systems. If any departures are deemed necessary by the Contractor, details of such departures and the reasons therefor shall be submitted within 30 days after award of the contract to the Contracting Officer for approval. No such departure shall be made without prior written approval of the Contracting Officer. The Contractor shall be responsible for providing properly sized circuit breakers to serve equipment and motors furnished which differ from those specified or indicated. This shall be further understood to include branch circuit wiring, conduit, disconnect switches, etc., in accordance with the appropriate codes and specifications. The cost of providing this increased electrical service and related work shall be included under the applicable section under which the equipment and motors are being furnished. In each of the standards referred to herein, the advisory provisions shall be considered to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Reference in these standards to the "authority having jurisdiction", or words of similar meaning, shall be interpreted to mean the Contracting Officer.

4. ELECTRICAL SERVICE FOR BUILDINGS: Building service: Voltages shall be as indicated on the drawings. Final connections to the power distribution system at the existing panelboards and transformer shall be made by the Contractor as directed by the Contracting Officer.

4.1 Service into Buildings and Industrial Waste Collection and Treatment Facilities: Underground conduit for service feeders shall be rigid steel from the service equipment to a point five feet beyond the building and projections thereof. The underground portion of the conduit shall be encased in a concrete envelope having a wall thickness of not less than three inches and shall be buried not less than 24 inches.

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Where a conduit enters through a concrete floor, the curved portion shall not be visible above the finished floor, and the entire conduit below the floor slab shall be encased in a concrete envelope having a wall thickness of not less than three inches. Where underground service connections enter a building above the ground floor, a suitable pull box shall be provided.

4.2 Service Entrance Equipment: UL 869 and NEMA KSI, as applicable. Main building service equipment shall consist of circuit breakers or fused disconnect switches.

5. MATERIALS AND EQUIPMENT: All items including, but not limited to devices, outlets, boxes, and fittings shall be sized in accordance with the National Electrical Code (NEC) unless indicated or specified otherwise.

5.1 Conduit and Fittings:

5.1.1 Zinc-coated Rigid Steel Conduit: ANSI C80.1

5.1.2 Zinc-coated steel Intermediate Metal Conduit (IMC): UL 1242, threaded type, including fittings.

5.1.3 Electrical Metallic Tubing (EMT): ANSI C80.3.

5.1.4 Flexible Zinc-coated Steel Conduit: UL 1 and shall have an extruded moisture and oil-proof PVC jacket for installation where indicated and in areas subject to abnormal moisture. Watertight connectors shall be used with PVC covered conduit.

5.1.5 Wireways: Zinc-coated rigid steel sheets, formed into rectangular or square shapes, totally enclosed with hinged cover or cover fastened with screws, and sized as required by NFPA 70. Wireways shall be provided complete with all necessary accessories and fittings.

5.1.6 Cable Troughs/Trays: Prefabricated expanded metal, approximately 12 gage, hot dipped galvanized after fabrication. The trough shall be provided complete with necessary fittings, couplings, bends, connectors, knock outs, dropouts, end fittings, grounding fittings, tees, conduit connectors, cable straps or anchors, reducers, hangers, thru-wall seals and all other accessories.

5.1.7 Fittings: UL 467 and UL 514, as applicable, for rigid metal conduit, flexible metal conduit, EMT, and service-entrance cable. Fittings for EMT shall be compression (threaded) type. Fittings for rigid metal conduit shall be threaded. Fittings for all conduit types shall be of the same material as the conduit and when installed in wet locations and underground, they shall provide a watertight joint.

5.1.7.1 Expansion Joint Fittings: Where conduits pass through building expansion joints, waterproof telescopic type expansion fittings shall be used. Fittings shall be watertight and permit a movement up to 4 inches and shall be equipped with approved bonding jumpers around or through each fitting.

5.1.7.2 Sealing Fittings or Bushings of appropriate type shall be used where conduits pass from hazardous areas to areas of normal atmosphere. Fittings or bushings shall be installed in easily accessible locations.

5.2 Boxes and Outlets: UL 514 except that boxes for hazardous locations shall conform to UL requirements for the class and group indicated or specified. Boxes shall be provided with screw fastened cover. Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the cast metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, in hazardous areas, and when installed exposed up to 7 feet above interior floors and walkways. Boxes in other locations shall be sheet steel.

5.2.1 Sizing Boxes: Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes, required by structural conditions, are approved. Boxes for other than lighting-fixture outlets shall be not less than 4 inches square except that 4 inch by 2 inch boxes may be used where only one raceway enters the outlet. Boxes less than 4 inches for mounting lighting fixtures may be installed as required by fixture configuration, as approved.

5.2.2 Pull Boxes: Shall be constructed of code-gage aluminum or galvanized sheet steel except where cast-metal boxes are required in locations specified hereinbefore.

5.3 Covers and Device Plates: Covers and device plates of the one piece type shall be provided for all outlets and fittings to suit the devices installed. Plates on unfinished wall and on fittings shall be zinc coated steel or cast metal having round or beveled edges. Plates on finished walls shall be satin-finish stainless steel or brushed-finish aluminum. Screws shall be machine type with countersunk heads, painted or finished to match the plate. Steel and aluminum plates shall be minimum 0.03 inch thick.

5.4 Receptacles: W-C-596, grounding type rated 20 amperes and 125 volts. Bodies shall be brown thermosetting plastic composition, supported on a metal mounting strap. Receptacles shall be side-wired with binding-type terminals. Back-wired, clamp-type terminals are not acceptable. The grounded pole shall be connected to the mounting strap.

5.5 Toggle Switches: UL 20, totally enclosed type with bodies and handles of brown thermosetting plastic and a mounting strap. Wiring terminals shall be of the screw type, side wired. Backwired clamp-type terminals are not acceptable. Switches shall be rated quiet type, AC only, 20 ampere, 120-277 volt, single-pole, as indicated.

5.5.1 Weatherproof Switches: Provide in weatherproof enclosures with external operating handles.

5.6 Wires and Cables: Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils. Minimum conductor size shall be No. 12 AWG except control wires and cables shall be minimum No. 14 AWG. Wires No. 8 and larger shall be stranded. Conductors No. 6 AWG and smaller shall be copper. Conductors No. 4 AWG and larger shall be either copper, aluminum or copper-clad aluminum. Conductor and conduit sizes indicated are for copper conductors. If aluminum or copper-clad conductors are used, they shall have equivalent copper conductor current carrying capacity and the conduit sizes shall be increased in conformance with the maximum conduit fill requirements of the NEC.

5.6.1 Power and Lighting Conductors: UL 83, type THW or THWN.

5.6.2 Service Entrance and Underground Secondary Conductors: UL 854, type USE, single conductor, rated 600 volts. Cable shall be suitable for direct burial in earth or for installation in conduit.

5.6.3 Grounding and Bonding Conductors: ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B8, class B, stranded bare copper wire for sizes No. 6 AWG and larger. Grounding and bonding conductors shall be insulated type where indicated.

5.6.4 Flexible Connections: Connections to movable equipment shall be flexible metal conduit with the number of conductors indicated and heavy-duty type SO cable having a green equipment ground conductor in addition to the current carrying conductors.

5.6.5 Color Coding: Service, feeder, branch, control and signalling circuit conductors shall be color-coded. Conductor identification shall be provided within each enclosure where a tap, splice or termination is made. Conductor identification shall be by color insulated conductors, plastic coated self sticking printed markers, colored nylon cable ties and plates, or heat-shrink type sleeves. Control and signalling circuit terminations shall be identified.

Color coding for 208 and 480 volt systems shall be:

208 VOLT SYSTEM

Neutral - White
Phase A - Black

460 VOLT SYSTEM

Neutral - White
Phase A - Brown

Phase B - Red
Phase C - Blue
Grounding Conductor - Green

Phase B - Orange
Phase C - Yellow
Grounding Conductor - Green

5.6.6 Control and Signalling Circuit Conductors: Type THW. Multiple conductor control cables may be used for control circuits, at the Contractor's option, in lieu of many single conductors. Control and signalling circuit conductors shall have the same insulation level as power circuit conductors if they are run in the same conduit.

5.7 Splice and Termination Components: UL 486 for wire connectors and soldering lugs, UL 510 for insulating tapes. Connections in wires No. 10 AWG and smaller shall be made with insulated pressure type connectors or wirenut type connectors. Splices for wires No. 8 AWG and larger shall be made with a solderless connector.

5.8 Panelboards: UL 67 and UL 50, as applicable. Lighting and appliance branch circuit panelboards shall be factory assembled automatic circuit breaker type. Distribution, power, feeder, motor starter, or panelboards shall be circuit breaker equipped. Complete panelboard assembly shall be so designed that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances and other requirements of UL. Where "space only" is indicated, provisions shall be made for the future installation of a breaker sized as indicated.

5.8.1 Buses for Panelboards: Provide an insulated neutral bus for each panel for connection of both feeder and branch circuit neutral wires. A separate ground bus, marked with a green stripe along its front and bonded to the steel cabinet, shall be provided for connecting all ground conductors. Bus bars shall be copper, shall be securely fastened to bases, and shall not depend upon breakers for support. All main buses and back pans shall be so designed that branch breakers may be changed without additional machining, drilling, or tapping.

5.8.2 Circuit Breakers: W-C-375, Type II (ambient-compensated thermal magnetic type) and shall have a minimum interrupting capability of 10,000 amperes symmetrical. Breakers shall be designed to accept copper, copper-clad, and aluminum conductors. Plug-in type circuit breakers are not acceptable.

5.8.2.1 Multipole Breakers: Common-trip type having a single operating handle and designed so that any overload in one pole automatically causes all poles to open. Any three adjacent breaker poles shall be connected to Phases A, B and C respectively and that same relationship of phase sequence shall be maintained.

5.9 Switches: Disconnect switches shall be heavy-duty fused, single throw, quick-make quick-break, and 3 pole, 240 or 600 volts, as required, NEMA Type 1 enclosure unless otherwise indicated. Switch

shall have no cover interlock. Switches serving as motor-disconnect means shall be horsepower rated in conformance with NEMA KSI. Fused switches shall be provided with fuse-holders to accept the fuse type specified.

5.10 Fuses: Provide a complete set of fuses for all switches. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage ratings not less than the circuit voltages.

5.10.1 Cartridge Fuses, Current-Limiting Time-Delay Type: UL 198.3, Class K-1, rated 250 or 600 volts ac and having an interrupting rating of 100,000 amps rms symmetrical.

5.11 Motors: NEMA MG1. The approximate size of each motor is indicated. Check motor sizes and characteristics to insure that correctly sized starters and overload heaters are provided for the motors. Motors shall be adequately sized for the required duty and shall not exceed their nameplate full-load current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. Motors provided for operation on 480, 240, and 208 volt circuits shall have a voltage rating of 460, 230 or 200 volts, respectively. Motors shall be designed to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be suitable for across-the-line starting. Motors above 1/3 horsepower shall operate on 480 or 208 volt, 3 phase, 60 Hertz current, unless indicated otherwise. Motors, 1/3 horsepower and below shall operate on 120 volt, single phase, 60 Hertz current.

5.12 Controllers: NEMA ICS 1,2,3,4 and 6: Controllers or starters and controls shall be furnished as part of the equipment on which they are used unless indicated otherwise. Each type of controller shall contain thermal running overload protection and manual reset means. Where control voltages differ from motor voltage, a control-voltage transformer shall be provided in and as part of the starter. Starters for motors without automatic control shall have built-in "start-stop" pushbuttons. Starters for motors under automatic control shall have built-in "hand-off-auto" selector switch. All starters and controls shall be NEMA 1 enclosed where mounted as indicated. Starters and controls mounted outside or where specifically called for shall be NEMA 3R enclosed or NEMA 7 as indicated.

5.12.1 Manual Starters shall be single pole type designed for surface mounting. Motor controllers for manual control of single phase motors shall be the enclosed toggle switch type.

5.12.2 Combination Starters with circuit breaker in the same enclosure shall be furnished where indicated. Circuit breaker shall conform to the requirements of this section of the specifications.

5.12.3 Pushbutton Stations shall have "start-stop" momentary contacts, having one normally-open and one normally-closed set of contacts, with ruby indicating lights to indicate when motors are running. Stations shall be heavy-duty type designed for flush or surface mounting, as required. Pilot and indicating lights shall be neon type.

5.12.4 Selector Switch: When used with a pressure, float or similar automatic type of maintained-contact switch, the controller shall have a hand-off-automatic selector switch. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the "hand" position. All safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protection devices shall be connected in the motor control circuit in both "hand" and "automatic" positions unless indicated otherwise.

5.12.5 Control elements such as float switches, bubbler systems timers and alarms are specified in the section entitled "Controls and Alarms".

5.13 Motor Starting Panelboard: Refer to Paragraph 5.8. The units shall be front-accessible and designed for mounting against a wall. The starting panelboard shall be equipped with the required pull boxes, conduit access spaces, and horizontal and vertical wiring channels necessary to provide easy installation and neat construction.

5.13.1 Rating: The motor starting panelboard shall be rated 600 volts with copper bus rated and braced for short circuits, as indicated on the drawings.

5.13.2 Combination Starters: Each starter shall be a combination circuit breaker and starter. Circuit breakers shall be provided where specifically called for on the drawings. Circuit breaker handles shall be operable from the outside front of the access door and shall be interlocked so that the door cannot be opened unless the breaker or switch is in the "off" position. The switch or breaker shall have provisions for padlocking in any position. Each starter shall have a red pilot light in the front door to indicate when the motor is running. The units shall be bolted in place.

5.13.3 Components: The motor control panelboards shall contain starters, relays, pilot lights, breakers, time switches, pushbuttons, HOA switches, etc., as scheduled on the drawings. Components such as starters, breakers, etc., shall be as specified under other paragraphs of this Section. Control components and alarms as specified in the section entitled "Controls and Alarms" shall also be included in control panels as indicated.

5.14 Grounding and Bonding Equipment: UL 467.

5.14.1 Equipment Grounds: A green-colored equipment grounding conductor which shall be separate from the electrical system neutral conductor shall be provided. Equipment ground conductors shall be provided in all branch circuits serving convenience outlets, receptacles, portable and permanently installed electrical appliances, equipment, apparatus and other miscellaneous metal-enclosing bodies normally within contact of personnel.

5.14.2 Ground Rods: Rolled commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have a tensile strength of 65,000 pounds per square inch (psi). The rods shall be not less than 3/4 inch in diameter by 10 feet in length and shall have a hard, clean, smooth, continuous copper surface and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.013 inch at any point on the rod.

5.14.3 Hazardous Areas: A special equipment grounding system shall be provided in areas designated "hazardous", consisting of Class I, Group "D", Division 1, equipment.

5.15 Dry-Type Transformers: NEMA ST-20 general-purpose, constant-potential, self-cooled totally-enclosed type. Transformers shall be housed in a NEMA 1 enclosure and shall have a temperature rise not exceed 150 degrees C under full load in a maximum ambient of 40 degrees C. Transformers shall have a minimum of 10 percent overload capacity at rated voltage. Full capacity NEMA stranded taps, two 2-1/2% above and 2-1/2% below rated voltage shall be provided in the high voltage winding. Transformers shall be the quiet type with an average sound level of at least 3 decibels lower than NEMA standard sound levels for the transformer size indicated. Transformers shall be provided complete with mounting brackets or hangers.

5.16 Control Panels: Panels shall be provided as indicated on drawings and shall conform to requirements of section entitled "Controls and Alarms".

6. INSTALLATION: Electrical installation shall conform to the National Electrical Safety Code, the National Electrical Code and to the requirements specified herein. Mounting heights specified or indicated shall be measured to the center of the device or outlet.

6.1 Conduit, Fittings and Support:

6.1.1 Use of Specific Types: Aluminum conduit shall not be installed underground, shall not be encased in concrete, shall not be used in any wall or slab in contact with earth, and shall not be used with brass or bronze fittings. Electrical metallic tubing shall not be used in floor slabs, outside walls, below grade, or exposed unless a minimum of 6 feet above floor, except that it may be used for serving

exposed light switch boxes mounted at least 4 feet 6 inches above floor and fed from above. Flexible conduit shall be used for connections to motors and other equipment subject to vibration for connections to recessed or semi-recessed fixtures, and where indicated. Intermediate metal conduit shall be installed according to the NEC, except as modified herein.

6.1.2 Conduit Installation, General Requirements: Conduit shall be installed exposed on walls, floors and ceilings. Maintain a minimum distance of 6 inches from parallel runs of flues, steam or hot water pipes. For floor mounted equipment, conduit may be run overhead and dropped down, where underfloor installation is not practicable. Groups of conduit shall be uniformly spaced, where straight and at turns. Bends and offsets, where unavoidable, shall be made with hickey or bending machine. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Expansion fittings shall be installed in conduit where it passes through structural expansion joints. Trapped conduits shall be avoided. Plaster, dirt or trash shall be prevented from lodging in conduits, boxes, fittings and equipment during construction. Clogged conduits shall be freed of all obstructions.

6.1.3 Conduit Support: Conduit shall be supported every 8 feet and shall be installed parallel with or perpendicular to walls, structural members or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 3 feet of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze. Fastenings shall be by wood screws to wood; by toggle bolts on hollow masonry units, by expansion bolts on concrete or brick; by machine screws, welded threaded studs or spring-tension clamps on steel work. Explosive-drive equipment may be used to make connections where the use of this equipment complies with safety regulations. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel structures. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceiling shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws shall be used. Spring steel fasteners may only be used to support lighting branch circuit conduits to structural steel members. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the National Electrical Code, where insulated bushings are used and where bushings cannot be brought into firm contact with the

box. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulated type where required by the National Electrical Code.

6.1.4 Hazardous Locations: Conduit and wire installation in hazardous locations shall conform to the National Electrical Code for Class I, Division 1, Group D hazardous location.

6.1.5 Wireway: Provide where required by NEC.

6.2 Boxes and Outlets: Provide in the wiring or raceway systems for pulling of wires, making connections, and mounting of devices or fixtures. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Gaskets shall be provided on boxes and outlets where required to insure watertight installation.

6.2.1 Stub-Ups: Conduits stubbed up through concrete floors for connections to free-standing equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.

6.3 Covers and Device Plates: Install with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed.

6.4 Receptacle Mounting: Mount 18 inches above finished floor, unless indicated otherwise.

6.5 Toggle Switches: Install singly or in gangs, as indicated, located 3 feet 10 inches above finished floor levels and connect so as to afford control over the indicated outlets.

6.6 Wiring - General: Suitable equipment shall be used to pull conductors through conduit, exercising due care to avoid damage to insulation. Wires shall not be pulled through conduits before the conduit system is complete and has been carefully freed from obstruction of any kind. Soapstone or an approved compound may be employed to facilitate pulling wires. Where two or more circuits are housed in one conduit, a common neutral may be used if sized in compliance with NEC. If aluminum conductors are provided, care shall be used in making up

joints and terminations. Surface oxides shall be removed by cleaning with a wire brush or emery cloth. Joint compound shall be used for connecting aluminum to aluminum. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically-bonded type. Wires and cables shall be installed in conduit unless indicated otherwise.

6.6.1 Flexible Cable: Install type "SO" cord as indicated on drawings.

6.7 Splices and Terminations: Splices and terminations shall be made in outlet or junction boxes and shall be mechanically and electrically secure, using proper thickness of tape. Uninsulated mechanical connectors of every kind shall be taped. Splices and terminations shall be covered with an insulation material equivalent to the conductor insulation. Connections involving aluminum conductors shall utilize approved type fittings and joint compound. Flashover or insulation value of joints shall be at least 100% in excess of wire insulation.

6.8 Panelboards: Mount so that the height of the top operating handle will not exceed 6 feet 6 inches from the floor.

6.9 Disconnect Switches: Provide where indicated.

6.10 Fuses: Provide in ratings indicated.

6.11 Motors and Controllers: Motors and controllers furnished under the division entitled "Mechanical" shall be installed under this section. Motors and controllers shall be mounted and wired to operate as indicated.

6.12 Motor Control Panelboard: Provide as indicated.

6.13 Grounding and Bonding: Except where specifically indicated otherwise, all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor of nonmetallic-sheathed cables, and neutral conductor of wiring systems shall be grounded. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection. If there is no metallic water service to the building, ground connection shall be made to driven ground rods on the exterior of the building. Where ground fault protection is employed, care shall be taken so that the connection of ground and neutral does not interfere with the correct operation of the fault protection.

6.13.1 Equipment Grounds: Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards.

Ground connections at panelboards, outlets, equipment and apparatus shall be made in an approved and permanent manner.

6.13.2 Resistance: The maximum resistance to ground of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Where the resistance obtained with one ground rod exceeds 25 ohms, additional ground rods shall be provided not less than 6 feet on centers.

6.14 Equipment Connections: All power wiring for the connection of motors and control equipment shall be provided under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications, but shall be provided under section entitled "Controls and Alarms".

6.15 Reworking Existing System: All work shall conform to applicable requirements of this Division of the Specifications. Existing electrical equipment, conduit, wire, etc., not in use after reworking and existing system, shall be removed or de-energized, as indicated. All equipment not scheduled for replacement, shall be kept in operation at all times. All work to be renovated, changed or modified shall be scheduled so as not to interfere with normal operation.

6.16 Repair of Existing Work: The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved, at no additional cost to the Government.

7. FIELD TESTS: The Contractor shall perform all field test and shall provide all labor, equipment and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.

7.1 Insulation resistance test for systems 600 volts and less. After all wiring is completed and connected ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed, insulation resistance tests shall be made in all feeder and subfeeder circuits. The insulation resistance between conductors and between such conductor and ground shall be measured. Measurements shall be made with an instrument capable of making measurements at an applied potential of 500 volts. Readings shall be taken after the voltage has been applied for a minimum of one minute.

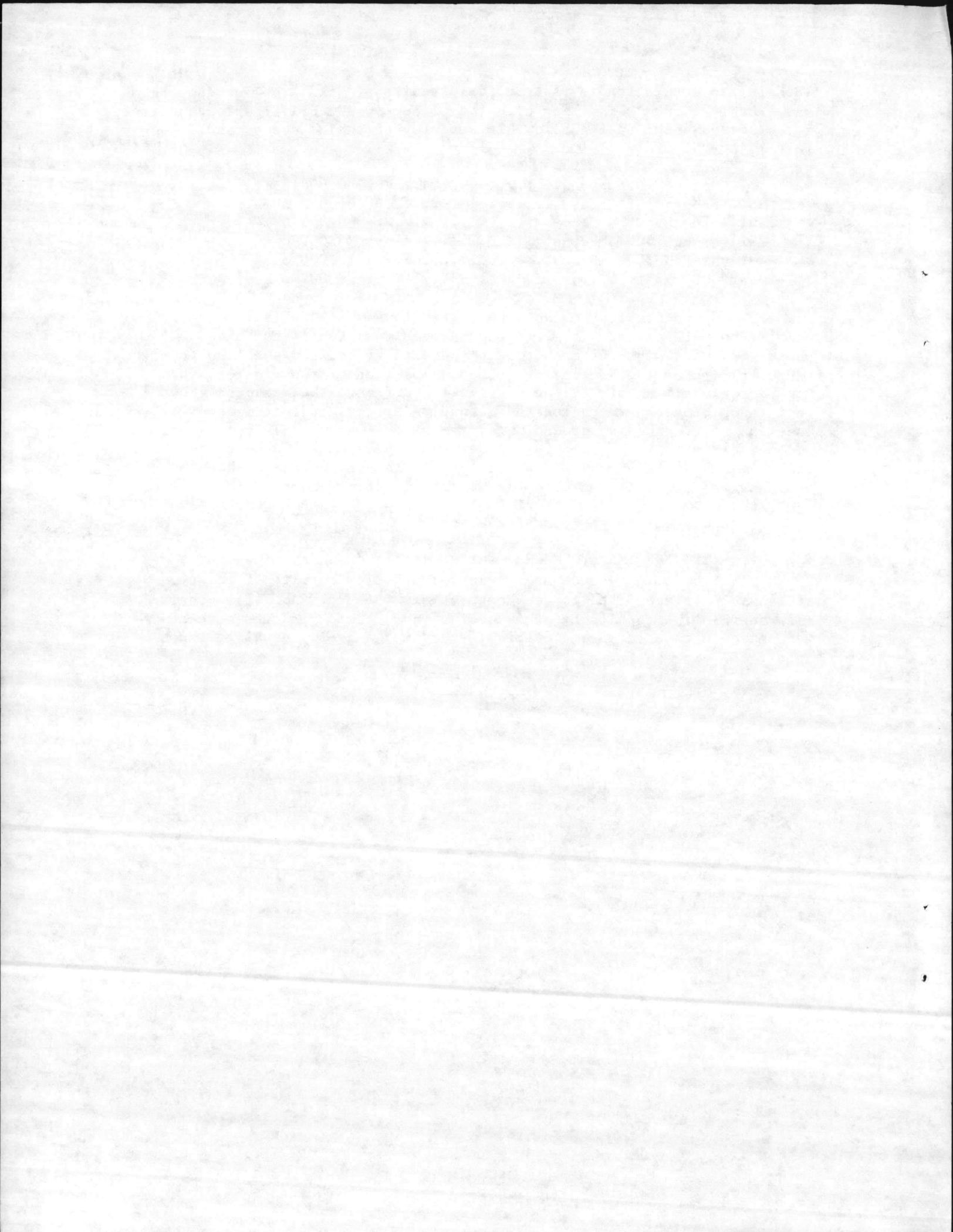
The minimum insulation resistance for circuits of No. 12 AWG conductors shall be 1,000,000 ohms. For circuits of No. 10 AWG or larger conductors, a resistance based on the allowable ampacity of the conductor shall be as follows:

25 through 50 amperes.....	250,000 ohms
51 through 100 amperes.....	100,000 ohms
101 through 200 amperes.....	50,000 ohms
201 through 400 amperes.....	25,000 ohms
401 through 800 amperes.....	12,000 ohms
Over 800 amperes.....	5,000 ohms

7.2 Grounding system shall be tested to assure continuity and compliance with the requirements that ground resistances not exceed 25 ohms. Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit to the Contracting Officer, the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground electrode under test isolated from other grounds. Ground resistance shall also be measured from each piece of equipment to the ground electrode.

8. TEST FOR TRANSFORMERS: Tests certified as "routine" per NEMA ST-20 shall be performed on each transformer. The results of these tests shall be submitted to the Contracting Officer. Submittals shall also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

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SECTION 16510. LIGHTING, INTERIOR

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

1.1 American National Standards Institute (ANSI) Publications:

C82.1-1972 Fluorescent Lamp Ballasts, Specification for,
including Supplement C82.1a-1973.

1.2 National Fire Protection Association (NFPA) Publications:

NFPA 70-1978 National Electrical Code.
NFPA 101-1976 Safety to Life from Fire in Buildings and
Structures, Code for

1.3 Underwriters' Laboratories, Inc. (UL) Publications:

57-1972 Fixtures, Electrical Lighting
(R OCT 77)
924-1977 Lighting and Power Equipment, Emergency
935-1971 Ballasts, Fluorescent - Lamp
(R NOV 77)

1.4 Lighting Fixture Plates Dated 11-77.

Nos. 16-A, Type 1, 16-V, & 16-CC

2. SUBMITTALS:

2.1 Shop Drawings: Submit shop drawings and data for lighting fixtures. Drawings shall show types, size, accessories, installation details, and other details of construction.

2.2 Manufacturers' Data: Submit manufacturers' data for all fixtures indicating mechanical and electrical construction.

2.3 Certificates: Submit certificates of conformance or compliance for the following: Light Fixtures.

3. GENERAL REQUIREMENTS: General requirements include those specified in Section 16011, General Requirements, Electrical and as specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, Interior Wiring Systems. These materials include branch circuit wiring and conduit, outlet boxes and fittings, and tapes, splices, and connectors. Lighting fixtures and accessories mounted on the exterior surfaces of buildings are included in this section of the specification.

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4. LIGHTING FIXTURES AND ACCESSORIES:

4.1 General: UL 57. Lighting fixtures shall be as indicated and as described on Lighting Plates Nos. 16-A, Type 1, 16-V, and 16-CC. Lighting fixtures shall be provided complete with lamps of the number, type and wattages shown. The details, shapes and dimensions are indicative of the general type desired, but are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equipment, light-distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

4.2 Ballasts for Fluorescent Fixtures: UL 935, ANSI C82.1, and shall be labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL). Ballasts shall be high power factor type and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be class P and shall have sound rating "A". Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees Celcius (C) when installed in an ambient temperature of 72 degrees Fahrenheit (F).

4.2.1 Energy Saving Ballasts: Provide energy saving fluorescent ballasts of the CBM certified full light output type. The ballasts shall have an average input wattage of 78 watts when operating two fluorescent lamps type F40LWRSWM. Ballasts shall be compatible for use with energy-saving lamps.

5. INSTALLATION: Lighting fixtures shall be set plumb, square, level, and in alignment and shall be secured in accordance with manufacturers' directions and approved shop drawings. The installation shall meet with the requirements of NEC. Mounting heights specified or indicated shall be to bottom of fixture. The exact mounting of lighting fixture shall be approved on the job before installation is commenced;

5.1 Exit and Emergency Lights: Exit lights, stairway and other emergency lights shall be wired on separate circuits and served from a separate breaker. The lights shall have only one control which shall be the circuit breaker.

6. FIELD TESTS AND INSPECTIONS:

6.1 General: The Contractor shall show by demonstration in service that all circuits, fixtures and equipment are in good operating condition. Tests shall be such that each piece of control equipment will function not less than five times. The Contractor shall give the Contracting Officer 7 days advance notice of the dates and times for tests and inspections.

6.2 Tests: Interior installations shall be tested for insulation resistance after all wiring is completed and connected ready for the attachment of fixtures and equipment, and again when fixtures and equipment are connected ready for use. Test shall be as specified in Section 16402: Interior Wiring Systems. All defective material and workmanship disclosed as the result of the tests given herein shall be corrected at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition.

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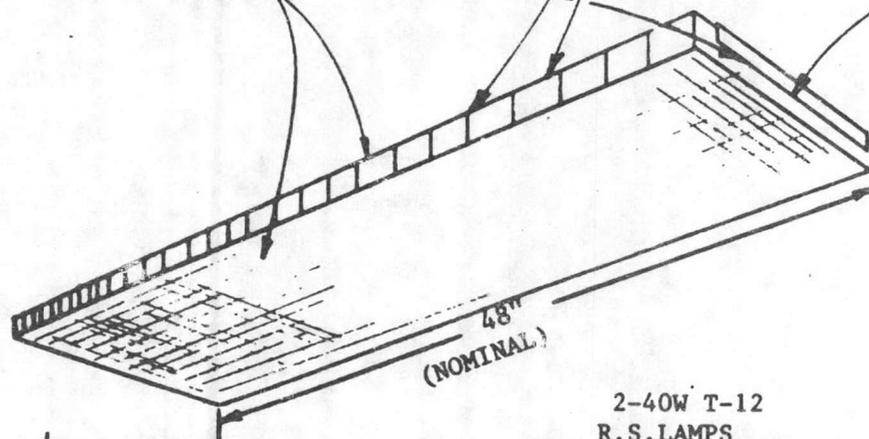
ONE PIECE 20 GAGE FORMED STEEL HOUSING,
CHEMICALLY TREATED FOR RUST PREVENTION,
FIXTURE TO HAVE BAKED, WHITE ENAMEL FINISH

LENS SHALL BE HINGED ALONG ENTIRE LENGTH
OF HOUSING

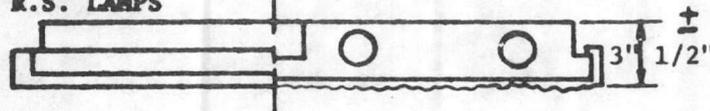
ONE PIECE INJECTION ACRYLIC PLASTIC LENS;
MINIMUM OF 1/8" THICK

BALLAST - HIGH POWER FACTOR
E.T.L., CBM APPROVED RAPID
START BALLASTS SHALL BE CLASS
"P" WITH SOUND RATING OF "A".

LUMINOUS PLASTIC ENDS

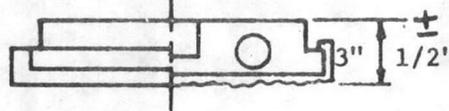


4-40W T-12
R.S. LAMPS



TYPE 2

2-40W T-12
R.S. LAMPS



TYPE 1

FIXTURE TYPE	NUMBER OF RAPID START LAMPS	WIDTH ± 1"
16-A-1	2	12"
16-A-2	4	16"

LANTDIV PLATE 16-A

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CAST ANODIZED SATIN
ALUMINUM HOUSING
WITH CLEAR LACQUER COATING
PROVIDE PORCELAIN SOCKET FOR
100W INCANDESCENT LAMP

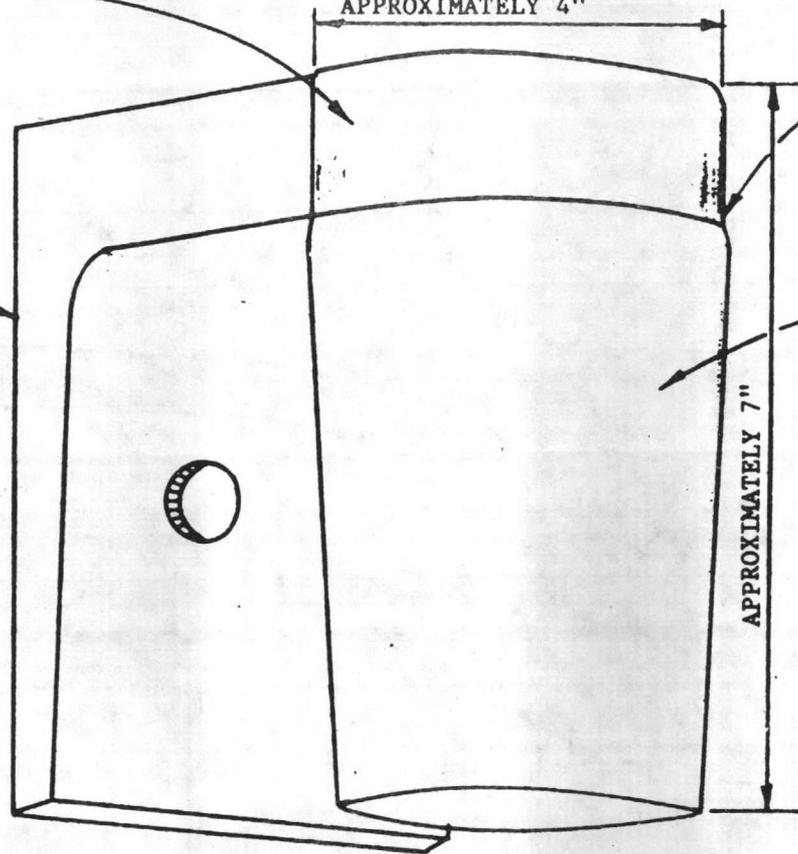
FOR WALL MOUNTING
PROVIDE NEOPRENE GASKET
BETWEEN FIXTURE AND WALL

APPROXIMATELY 4"

VAPORTIGHT GASKET

UNBREAKABLE WHITE POLYCARBO
ENCLOSING GLOBE

APPROXIMATELY 7"



TYPE 1

NOTE:
TYPE 2 FIXTURE SAME AS
TYPE 1, EXCEPT IT SHALL BE
FOR CEILING MOUNTING

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LANTDIV PLATE 16-V

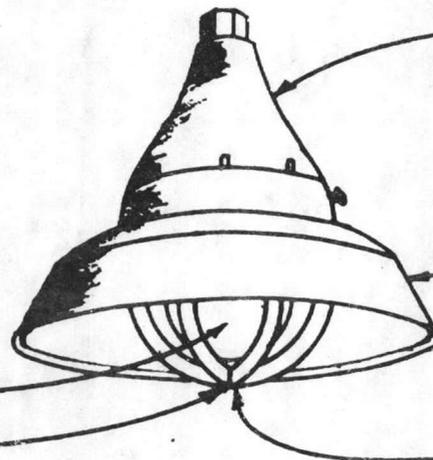
11-77

FLAMETIGHT THREADED JOINTS
AND GASKET SEALS

FIXTURE SHALL BE EXPLOSION PROOF
CLASS 1, DIV.1, GROUP D

HEAT AND IMPACT-RESISTANT
GLASS GLOBE

GLOBE GUARD



COPPER-FREE ALUMINUM
HOUSING WITH CELLULOSE
LACQUER FINISH

WHITE PORCELAIN ENAMELED
STEEL DOME REFLECTOR

FOR LAMPING, SEE
FIXTURE SHCHEDULE

TYPE 1: INCANDESCENT
TYPE 2: MERCURY VAPOR

LANTDIV PLATE 16-CC

11-77

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SUPERSEDEAS DECISION

STATE: North Carolina

COUNTIES: Statewide

DECISION NUMBER: NC84-1004

DATE: Date of Publication

Supersedes Decision No.: NC81-1148, December 30, 1980, 45 FR 86200

DESCRIPTION OF WORK: Water and Sewer and Sewer construction projects and Heavy construction projects excluding Dam construction projects.

	<u>Basic Hourly Rates</u>	<u>Fringe Benefits</u>
Boilermakers	\$16.20	3.315
Bricklayers	7.23	
Carpenters	6.63	
Cement Masons/Finishers	6.11	
Electricians	8.56	
Fence Erectors	4.64	
Ironworkers	8.20	
LABORRERS:		
Unskilled	4.41	
Air Drill Operator	5.92	
Asphalt Rakers	4.93	
Pipelayers	5.17	
Millwrights	5.27	
Painters	7.12	
Plumbers & Pipefitters	7.42	
Truck Drivers	4.67	
TV & Grouting Technicians	9.21	
POWER EQUIPMENT OPERATORS:		
Asphalt Distributors	5.77	
Asphalt Finishers	5.69	
Asphalt Pavers	5.69	
Asphalt Screeds	5.69	
Backhoe	6.40	
Boring Machine	5.65	
Bulldozer	5.96	
Crane	7.60	
Draglines	6.34	
Drills	7.23	
Loaders	5.79	
Manhole Builders	5.84	
Mechanics	7.16	
Motor Graders	6.24	
Rollers	4.98	
Scrapers, Pans	5.42	
Tractors	5.49	
Trenching Machines	6.58	
Well Drillers	6.50	

WELDERS:

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

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

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WAGE DETERMINATION

