

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

LIBRARY

ENGINEERING DIVISION

CONSTRUCTION SPECIAL PROVISIONS

FOR

SQUAW PEAK WATER TREATMENT PLANT

RELOCATIONS

AT THE

ARIZONA CANAL DIVERSION CHANNEL

CONTRACT NO. FCD 88-40

DECEMBER 1989

*JC Eng
3877 N. 7th
263-9500*

**SCHEMATIC - NOT FOR
CONSTRUCTION USE**

SUPPLEMENTARY TO MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM
STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION EDITION OF 1979
AND REVISIONS AND SUPPLEMENTS THERETO.

A118.552

To NPK
CC EAR

To RCP
CC JNK

From: Jan Warriner
Postmark: Dec 26,89 8:58 AM

Subject: Squaw Peak Water Treatment Plant

Message:

90% complete plans and specifications for the above referenced project will be delivered to your inbox today. Please have your staff review the plans and specs and submit comments by 1-11-90. The job consists of relocation of several large diameter water lines which will span the ACDC, and the construction of two vehicle access bridges for use by the Water Treatment Plant personnel. Nick, the structural design calculations will also be delivered to your inbox.

BIDDING SCHEDULE

Project: Squaw Peak Water Treatment Plant
Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-40

Page BS-1

Item No.	Approximate Quantity	Unit	Description	Unit Cost (in writing) and /100 Dollars	Unit Cost	Extended Amount
206-1	8,200	CY	Structural Excavation Bridge and Pipe Crossings			
206-2	2,950	CY	Structural Backfill Bridge and Pipe Crossings			
211-1	550	CY	Fill Construction			
301-1	2,900	SY	Subgrade Preparation			
310-1	290	CY	Aggregate Base Course			
321-1	323	TON	Asphaltic Concrete			
336-1	45	SY	Pavement Replacement M.A.G. Std. Det. 200 Type "A"			
350-1	1	LS	Démolish and Remove Structures and Slabs			
350-2	210	LF	Remove 36" R.C.P.			
350-3	141	LF	Remove 36" C.M.P.			
350-4	147	LF	Remove 48" R.C.P.			
350-5	141	LF	Remove 60" R.C.P.			
350-6	426	LF	Remove 66" R.C.P.			
350-7	200	LF	Remove 2" Water Line			

BIDDING SCHEDULE, CONTINUED

Item No.	Approximate Quantity	Unit	Description	Unit Cost (in writing) and /100 Dollars	Unit Cost	Extended Amount
350-8	50	LF	Remove 3" Water Line			
350-9	440	LF	Remove 4" Water Line			
350-10	280	LF	Remove Electric Duct Bank			
350-11	1	EA	Remove Electric Pull Boxes			
350-12	1,500	SY	Remove Asphalt Pavement			
350-13	1	LS	Miscellaneous Removals			
415-1	494	LF	Flexible Metal Guardrail			
420-1	100	LF	Chain Link Fence			
502-1	384	LF	Drilled Shaft Foundation			
505-1	402	CY	Structural Concrete			
505-2	42,520	LB	Steel Reinforcement			
506-1	1	LS	Transport, Erect and Repair Concrete Bridge Members			
506-2	1	LS	Post Tensioning For Bridges			
515-1	1	LS	Miscellaneous Metals			
520-1	54	LF	Handrail Three Rail Type			
520-2	360	LF	Handrail One Rail Type			

BIDDING SCHEDULE, CONTINUED

Item No.	Approximate Quantity	Unit	Description	Unit Cost (in writing) and /100 Dollars	Unit Cost	Extended Amount
1500-1	216	LF	66" Prestressed Concrete Cylinder Pipe with Fittings			
1500-2	298	LF	66" Fabricated Steel, Cement Mortar Lined Pipe with Fittings			
1500-3	158	LF	60" Fabricated Steel, Cement Mortar Lined Pipe with Fittings			
1500-4	161	LF	48" Fabricated Steel, Cement Mortar Lined Pipe with Fittings			
1500-5	70	LF	48" R.G.R.C.P. Class III, with Concrete Collar and Headwall			
1500-6	266	LF	36" Fabricated Steel, Cement Mortar Lined Pipe with Fittings			
1500-7	105	LF	36" R.G.R.C.P. Class III with Concrete Collars			
1500-8	350	LF	Concrete Encasement for Buried Steel Pipe			
1500-9	895	LF	4" D.I.P. Water Line with Fittings			

BIDDING SCHEDULE, CONTINUED

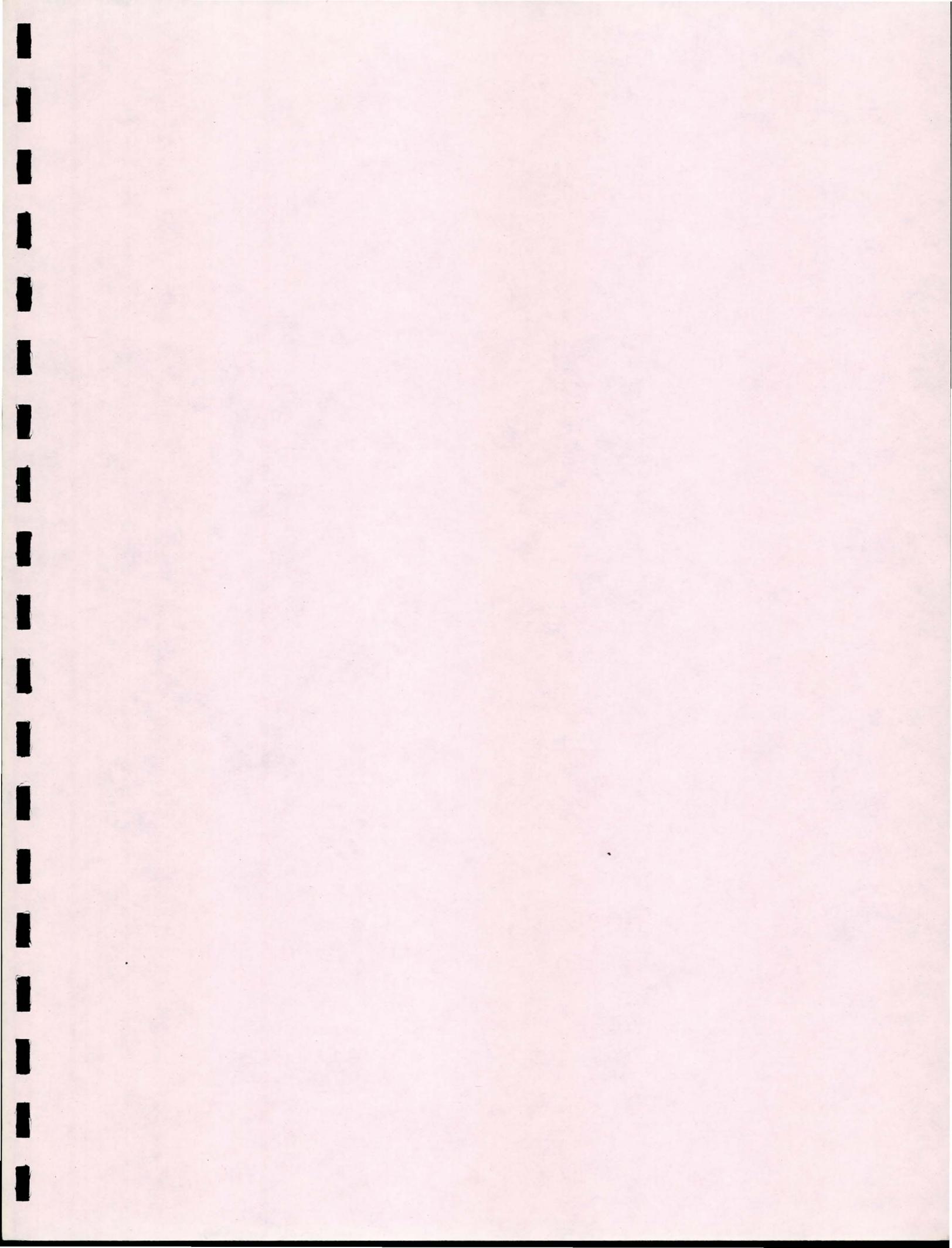
Item No.	Approximate Quantity	Unit	Description	Unit Cost (in writing) and /100 Dollars	Unit Cost	Extended Amount
1500-10	1	LS	3" D.I.P. and Hose Bibb with Fittings			
1500-11	1	LS	2" Copper Water Line and Saddle Tap with Fittings			
1500-12	100	LF	4" Stainless Steel Chemical Line with Fittings			
1500-13	120	LF	4" Sch. 80 PVC Chemical Line with Fittings			
1500-14	1	LS	Temporary Chemical Line			
1500-15	1	EA	12" Combination Air/Vacuum Release Valve Assembly			
1500-16	2	EA	10" Combination Air/Vacuum Release Valve Assembly			
1500-17	1	EA	6" Combination Air/Vacuum Release Valve Assembly			
1500-18	4	EA	4" Gate Valve with Valve Box and Cover			
1500-19	2	EA	66" Flexible Pipe Coupling with Harness			
1500-20	1	EA	60" Flexible Pipe Coupling with Harness			

BIDDING SCHEDULE, CONTINUED

Item No.	Approximate Quantity	Unit	Description	Unit Cost (in writing) and /100 Dollars	Unit Cost	Extended Amount
1500-21	1	EA	48" Flexible Pipe Coupling with Harness			
1500-22	2	EA	36" Flexible Pipe Coupling with Harness			
1600-1	1	LS	Electrical			

TOTAL BID AMOUNT: _____

The Bidder hereby acknowledges receipt of and agrees his proposal is based on the following addenda.



CONSTRUCTION SPECIAL PROVISIONS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SQUAW PEAK WATER TREATMENT PLANT

RELOCATIONS AT THE

ARIZONA CANAL DIVERSION CHANNEL

CONTRACT NO. FCD 88-40

DECEMBER 1989



**JOHN CAROLLO
ENGINEERS**

PHOENIX, AZ · WALNUT CREEK, CA
SANTA ANA, CA · VISALIA, CA
SAN BERNARDINO, CA · TUCSON, AZ
SAN DIEGO, CA · BAKERSFIELD, CA
SACRAMENTO, CA · LOS ANGELES, CA
FRESNO, CA

HOWARD M. WAY, P.E.
GAIL P. LYNCH, P.E.
WALTER R. HOWARD, P.E.
J. DAVID GRIFFITH, P.E.
G. WILLIAM KNOPF, P.E.
GEORGE E. SHIRLEY, P.E.
GARY C. DEIS, P.E.
JOHN S. HECKLER, P.E.
WALTER A. BISHOP, JR., P.E.
DENNIS K. WOOD, P.E.
JOHN S. PUZAUSKAS, JR., P.E.
JAMEL DEMIR, P.E.

SCHEMATIC - NOT FOR CONSTRUCTION USE

CONSTRUCTION SPECIAL PROVISIONS FLOOD CONTROL DISTRICT OF MARICOPA COUNTY SQUAW PEAK WATER TREATMENT PLANT RELOCATIONS AT THE ARIZONA CANAL DIVERSION CHANNEL

TABLE OF CONTENTS

	<u>Page</u>
<u>CONSTRUCTION SPECIAL PROVISIONS</u>	
LOCATION OF THE WORK.....	1
PROPOSED WORK.....	1
STANDARD SPECIFICATIONS.....	1
PRECEDENCE OF CONTRACT DOCUMENTS.....	1
PAYMENT.....	1
NEGOTIATION CLAUSE.....	1
WORK STANDARDS.....	2
CONTRACT TIME.....	2
WATER, LIGHT, POWER, HEAT, TELEPHONE.....	2
WORK INVOLVED WITH EXISTING PLANT.....	2
PROGRESS SCHEDULE.....	3
MATERIAL SOURCES.....	4
101.2 DEFINITIONS AND TERMS.....	4
102 ADDENDA AND SUBMISSION OF BIDDING SCHEDULE.....	4
102.5 PREPARATION OF PROPOSAL.....	4
103.6 CONTRACTOR'S INSURANCE.....	4
104.20 SUBSURFACE INVESTIGATION.....	5
105.2 PLANS AND SHOP DRAWINGS.....	5
105.5 JOB OFFICE.....	6
105.6 COOPERATION WITH UTILITIES.....	6
105.8 CONSTRUCTION STAKES, LINES AND GRADES.....	7
105.10 INSPECTION OF WORK.....	7
106 CONTROL OF MATERIALS.....	7
106.5 CONTRACTOR'S STAGING AREA.....	8
107.2 PERMITS.....	8
108.5 LIMITATION OF OPERATIONS.....	8
108.9 FAILURE TO COMPLETE ON TIME.....	8
109 MEASUREMENTS AND PAYMENTS.....	8
201 CLEARING AND GRUBBING.....	9
205.6 DISPOSAL OF SURPLUS MATERIAL.....	9

TABLE OF CONTENTS, CONTINUED

<u>CONSTRUCTION SPECIAL PROVISIONS, CONT'D</u>		<u>Page</u>
206	STRUCTURE EXCAVATION AND BACKFILL.....	9
206.1	EXCAVATION SUPPORT.....	10
211	FILL CONSTRUCTION.....	13
301	SUBGRADE PREPARATION.....	13
310	UNTREATED BASE.....	14
321	ASPHALT CONCRETE PAVEMENT.....	14
336	PAVEMENT REPLACEMENT OR RESTORATION.....	14
350	REMOVAL OF EXISTING IMPROVEMENTS.....	15
401	TRAFFIC CONTROL.....	15
415	FLEXIBLE METAL GUARDRAILS.....	15
420	CHAIN LINK FENCES.....	15
502	DRILLED SHAFT FOUNDATIONS.....	15
505	CONCRETE BRIDGE STRUCTURES.....	21
506.1	PRECAST PRESTRESSED CONCRETE BRIDGE MEMBER.....	25
506.2	PRESTRESSING CONCRETE.....	26
506.2.1	DESCRIPTION.....	26
506.2.2	MATERIALS.....	26
506.2.2.1	REINFORCING STEEL AND PRESTRESSING STEEL.....	26
506.2.2.2	DUCTS.....	27
506.2.2.3	GROUT.....	27
506.2.2.4	STRUCTURAL STEEL.....	27
506.2.2.5	PORTLAND CEMENT CONCRETE.....	27
506.2.3	CONSTRUCTION REQUIREMENTS.....	27
506.2.3.1	SHOP DRAWINGS.....	27
506.2.3.2	APPROVAL OF PRESTRESSING SYSTEMS.....	28
506.2.3.3	SAMPLING AND TESTING.....	28
506.2.3.4	ANCHORAGE AND DISTRIBUTION.....	29
506.2.3.5	DUCT INSTALLATION.....	29
506.2.3.6	PRESTRESSING.....	30
506.2.3.7	GROUTING OF POST-TENSIONED MEMBERS.....	32
506.2.4	PAYMENT.....	33
515	STRUCTURAL AND MISCELLANEOUS METALS.....	34
515.1	GENERAL.....	34
515.2	MATERIALS.....	34
515.3	FABRICATION AND ERECTION.....	35
515.3.1	METAL FASTENING.....	35
515.3.2	BOLTING.....	35
515.3.3	HIGH STRENGTH BOLTS.....	36
515.3.4	WELDING.....	36
515.3.5	WELDING STEEL.....	37
515.3.6	STRUCTURAL METAL.....	37
515.3.7	STRUCTURAL STEEL.....	37
515.5	ANCHOR BOLTS AND INSERTS.....	38
515.5.1	INSTALLATION.....	38
515.5.2	CONCRETE ANCHORS.....	38
515.8	PAYMENT.....	39

TABLE OF CONTENTS, CONTINUED

	<u>Page</u>
<u>CONSTRUCTION SPECIAL PROVISIONS, CONT'D</u>	
520 STEEL HANDRAILS.....	40
600 WATER AND SEWER.....	40
601 TRENCH EXCAVATION, BACKFILLING, AND COMPACTING....	40
601.2.8 DEWATERING TRENCHES.....	40
611 DISINFECTING WATER MAINS.....	40
 <u>DIVISION 9 - FINISHES</u>	
090000 GENERAL.....	41
090100 PAINTING - GENERAL.....	41
090101 MANUFACTURERS' INSTRUCTIONS.....	42
090102 SPECIFIED PRODUCTS LIST.....	43
090103 PREPARATION OF SURFACES.....	44
090104 APPLICATION OF PAINT.....	46
090120 ITEMS NOT PAINTED.....	48
090140 PAINTING METAL SURFACES.....	48
090141 PRIMING OF METALS.....	48
090144 UNSUBMERGED METALS.....	49
090145 UNDERGROUND METALS.....	50
090146 PIPE COATINGS.....	50
090149 DISSIMILAR METALS.....	52
090170 PAINTING FIBERGLASS AND PLASTIC.....	52
090184 SPECIAL COLOR AND PAINTING REQUIREMENTS.....	53
090199 PAINTING SCHEDULE.....	54
 <u>DIVISION 15 - PIPING, VALVES, GATES, AND SPECIALTIES</u>	
150000 GENERAL.....	55
150010 EXPOSED PIPING.....	55
150011 WALL AND SLAB PENETRATIONS.....	56
150020 BURIED PIPING.....	56
150021 LAYING OF PIPE AND FITTINGS.....	57
150022 JOINTING OF RUBBER GASKETED PIPE.....	58
150023 STEEL SURFACES EXPOSED TO WATER OR EARTH.....	60
150025 LAYING OF DUCTILE IRON PIPE.....	60
150027 LAYING OF PVC PIPE OR CPVC PIPE.....	60
150030 CLEANING AND TESTING.....	61
150033 LIQUID PIPING TESTS.....	61
150036 POTABLE WATERLINES.....	62
150060 PIPING SCHEDULE.....	62
150070 CONNECTION TO IN-SERVICE LINES.....	64
150100 DUCTILE-IRON PIPE.....	64
150101 GROOVED-END DUCTILE-IRON PIPE - GENERAL.....	65
150102 GROOVED-END DUCTILE-IRON PIPE COUPLINGS.....	65
150110 JOINTS.....	66
150111 FLANGED JOINTS.....	66

TABLE OF CONTENTS, CONTINUED

	<u>Page</u>
<u>DIVISION 15 - PIPING, VALVES, GATES, AND SPECIALTIES, CONT'D</u>	
150112	MECHANICAL JOINTS..... 67
150113	PUSH-ON JOINTS..... 67
150120	FITTINGS..... 67
150121	PUSH-ON..... 67
150122	FLEXIBLE FITTINGS..... 67
150130	LINING AND COATING..... 67
150140	HANDLING OF PIPE AND FITTINGS..... 68
150160	CORROSION PROTECTION..... 68
150170	TESTING..... 68
150171	PRESSURE TEST..... 68
150172	LEAKAGE TEST..... 69
150200	STEEL PIPE..... 70
150210	JOINTS..... 70
150220	FITTINGS..... 71
150230	LINING..... 72
150231	CEMENT MORTAR LINING..... 72
150240	PIPE COATING..... 72
150241	CEMENT MORTAR COATING..... 72
150260	FABRICATED STEEL PIPE HEADERS..... 73
150290	STAINLESS STEEL PIPE..... 74
150310	STEEL CYLINDER PIPE - PRESTRESSED..... 75
150800	COPPER PIPE AND TUBING..... 77
150810	ASTM B 88 TUBING..... 78
150820	ASTM B 280 TUBING..... 78
150830	INSTALLATION..... 78
151400	REINFORCED CONCRETE PIPE..... 79
151410	JOINTS..... 79
151420	FITTINGS..... 79
151430	CURVES..... 79
151440	PIPE DELIVERY AND HANDLING..... 79
151450	TESTING..... 80
151800	PLASTIC PIPE, TUBING, AND FITTINGS..... 80
151810	POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS..... 81
151820	CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS..... 81
152100	PIPING SPECIALTIES..... 81
152110	FLEXIBLE PIPE COUPLINGS..... 81
152135	PIPE SADDLES..... 82
153000	VALVES..... 82
153010	INSTALLATION OF VALVES..... 84
153200	GATE VALVES ABOVEGROUND..... 84
153210	GATE VALVES UNDERGROUND..... 84
153500	BALL VALVES..... 85
153510	METAL BODY BALL VALVES..... 85
153700	HOSE VALVES..... 85
153710	PLAIN HOSE VALVES..... 85

TABLE OF CONTENTS, CONTINUED

		<u>Page</u>
<u>DIVISION 15 - PIPING, VALVES, GATES, AND SPECIALTIES, CONT'D</u>		
153841	COMBINATION AIR-VACUUM RELEASE VALVES.....	85
154500	VALVE AND GATE OPERATORS.....	85
154600	PIPE HANGERS AND SUPPORTS.....	87
154610	ANCHOR BOLTS AND INSERTS.....	88
154620	SINGLE PIPE HANGERS AND SUPPORTS.....	89
154621	WALL OR CEILING CLAMPS.....	89
154630	TRAPEZE HANGERS.....	89
154640	WALL BRACKETS.....	89
 <u>DIVISION 16 - ELECTRICAL</u>		
160100	GENERAL.....	90
160101	GENERAL PROVISIONS.....	90
160102	WORK INCLUDED.....	91
160103	REGULATIONS AND CODES.....	91
160105	TEMPORARY POWER.....	91
160106	CUTTING AND REPAIRING.....	91
160107	CORROSION PROTECTION.....	91
160109	TEST.....	92
160110	CONFORMS TO RECORD DOCUMENTS DRAWINGS.....	92
160111	SINGLE LINE DIAGRAMS.....	92
160112	CIRCUIT IDENTIFICATION.....	92
160113	NAMEPLATES.....	93
160115	HIGH VOLTAGE WARNING SIGNS.....	93
160116	CONDUCTOR FASTENERS.....	93
160200	GENERAL MATERIALS AND METHODS.....	94
160201	GENERAL.....	94
160202	RACEWAYS.....	94
160203	CONDUCTORS.....	97
160204	GROUNDING.....	99
160205	OUTLET, SWITCH, PULL AND JUNCTION BOXES.....	100
160212	ENCLOSURES.....	101
160218	TERMINAL BLOCKS.....	101
161100	CIRCUIT BREAKERS - LOW VOLTAGE.....	101
163100	LIGHTING.....	102
163110	GENERAL.....	102
163120	INSTALLATION.....	102
163130	BALLASTS.....	102
169000	PAYMENT.....	103

TYPICAL DETAILS

SD-1 - 18

CONSTRUCTION SPECIAL PROVISIONS
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
SQUAW PEAK WATER TREATMENT PLANT
RELOCATIONS AT THE ARIZONA CANAL DIVERSION CHANNEL

LOCATION OF THE WORK

This project is located at the Squaw Peak Water Treatment Plant (WTP), 2202 East Maryland Avenue, Phoenix, Arizona.

PROPOSED WORK

The work consists of relocating 66-inch and 60-inch water mains, 66-inch and 48-inch raw water lines, two 36-inch plant wash water lines, electrical duct banks, constructing two vehicular access bridges, and other miscellaneous items of work required for the completion of the project.

STANDARD SPECIFICATIONS

The provisions of MAG Uniform Standard Specifications and Details for Public Works Construction dated 1979, as modified by the City of Phoenix, which are not altered or modified by the Drawings, General Conditions or by these Special Provisions or by any subsequently issued Addendum shall apply to the Contract even though the Contractor's attention is not specifically drawn to such provisions.

PRECEDENCE OF CONTRACT DOCUMENTS

City of Phoenix Supplements to MAG Specifications and Details will govern over the MAG Standard Specifications and Details. In case of a discrepancy or conflict, Project Plans will govern over the City of Phoenix Supplements, the MAG Standard Specifications and Details. These Construction Special Provisions will govern over the City of Phoenix Supplements, the MAG Standard Specifications and Details, and the Project Plans.

PAYMENT

Payment will be made for only those items listed in the Proposal and will not be made in accordance with the measurement and payment provisions of the Standard Specifications where this differs from the items listed in the Proposal. All materials and work necessary for completion of this project are to be included in Proposal items. Any work or material not specifically referred to in these items is considered incidental to the item and included in the unit price.

NEGOTIATION CLAUSE

Recovery of damages related to expenses incurred by the Contractor for a delay for which the Flood Control District of Maricopa County is responsible, which is unreasonable under the circumstances and which was not

within the contemplation of the parties to the Contract, shall be negotiated between the Contractor and the Flood Control District of Maricopa County. This provision shall not be construed to void any provision in the Contract which requires notice of delays, provides for arbitration or other procedure for settlement or provides for liquidated damages.

WORK STANDARDS

The Contractor shall comply with Sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-330) as supplemented by Department of Labor Regulations (29 CFR Part 5).

CONTRACT TIME

The Contractor shall start work within seven (7) calendar days after Notice to Proceed, and shall complete all work by January 31, 1991.

Work which must be accomplished during the Arizona Canal north side dry-up shall be scheduled to occur approximately between mid-November 1990 and mid-December 1990. The Contractor shall verify exact dates for the dry-up with the Salt River Project.

It is anticipated that a Contract for construction of the Arizona Canal Diversion Channel will be awarded before the completion of this Contract. However, construction of the Arizona Canal Diversion Channel through the plant site is not expected to occur prior to January 31, 1991.

WATER, LIGHT, POWER, HEAT, TELEPHONE

All water for construction purposes, drinking water, lighting, temporary electric power, heat and telephone service shall be arranged for and provided for the requirements of the work by the Contractor at his expense.

WORK INVOLVED WITH EXISTING PLANT

The Work under this Contract must be accomplished while the existing plant is in operation. The work that is involved with the existing plant must be done so that operation of the existing plant will not be jeopardized or materially reduced in efficiency as a result of the work under this Contract.

Work on this Contract must be coordinated with the operation of the plant. The Contractor shall notify the Engineer in writing of the Contractor's planned procedure for each specific alteration of existing facilities before the alteration begins. The Contractor shall provide three written notices to the treatment facility manager for any work that will impact plant operation. These notices are required 60, 30, and 7 days prior to starting work and shall note impact on operation, start of impact, and duration. The Contractor shall not begin an alteration until specific permission has been granted by the treatment facility manager in each case. The Engineer will coordinate the Contractor's planned procedure

with the treatment facility manager. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be completed as quickly as possible and with as little delay as possible.

Any operational functions of the existing plant that are required to be performed to facilitate the work of the Contractor shall be performed by the plant personnel only, or under the direct supervision of plant personnel.

The plant operation and maintenance personnel will cooperate in every way that is practicable in order to expedite the work of the Contractor; however, if it is necessary for the proper operation or maintenance of portions of the plant, the Contractor shall reschedule his operations so that his work will not conflict with necessary operations or maintenance of the plant.

The Contractor shall maintain access roads to all parts of the existing plant.

The work under this Contract that is involved with the existing plant is indicated in the Contract Documents.

In particular, the Contractor shall schedule the work to adhere to the following construction constraints:

1. Existing 66-inch water main and 60-inch water main shall not both be out of service at the same time.
2. Existing 66-inch water main and 60-inch water main shall each be out of service for a maximum time period of one calendar week.
3. Existing 66-inch water and 60-inch water main shall not be out of service between May 15, 1990 and October 15, 1990, nor during Arizona Canal south side dry-up (approximately between mid-October 1990 and mid-November 1990).
4. Connections to existing 66-inch raw water, 48-inch raw water, 36-inch Plant I wash water, and 36-inch Plant II wash water shall occur within the Arizona Canal north side dry-up.
5. Existing electrical duct banks and miscellaneous plant utilities shall be relocated so as to minimize impacts on the operation of the existing plant.

PROGRESS SCHEDULE

The Contractor shall submit his proposed work progress schedule to the Chief Engineer and General Manager for approval before starting the work.

MATERIAL SOURCES

Select material, aggregate base and mineral aggregate shall be obtained from commercial sources. The Contractor shall pay all royalties, or any other charges or expenses, incurred in connection with the securing and hauling of the material. The Contractor will be required to furnish the Engineer with a list of his proposed commercial sources prior to use, and shall present certificates stating that the material produced from any commercial sources is in accordance with the Uniform Standard Specifications and these Special Provisions.

101.2 DEFINITIONS AND TERMS

Change the definition of the Budget Project to read as follows: A project financed by funds set aside in the annual budget or otherwise approved by the Board of Directors of the Flood Control District of Maricopa County.

Change the definition of Engineer to read as follows: The Chief Engineer and General Manager of the Flood Control District of Maricopa County acting directly or through his duly authorized representative.

Change the definition of Owner to read as follows: The Flood Control District of Maricopa County, acting through its legally constituted officials, officers or employees.

102 ADDENDA AND SUBMISSION OF BIDDING SCHEDULE

It shall be the responsibility of prospective bidders to determine, prior to submission of a bid, if any addenda have been issued. This may be accomplished by calling 602-262-1501. Any addendum issued, if not already bound into the Special Provisions, must be included as a part of the Special Provisions, and any quantities on the Bidding Schedule requiring change shall be adjusted by pen and ink to the new figure.

Bids that do not include appropriate addenda and show appropriate changes to the Bidding Schedule shall be invalid.

102.5 PREPARATION OF PROPOSAL

The bidder's Arizona State Contractor's License number and classification shall be shown on the Proposal. The possession of such a license is a bidding requirement; in addition, the Contractor may be required to provide certification of prior satisfactory completion for similar construction.

103.6 CONTRACTOR'S INSURANCE

Concurrently with the execution of the contract, the Contractor shall furnish a Certificate of Insurance. The types of insurance and the limits of liability shall be as indicated thereon, i.e.:

\$1,000,000 bodily injury per person
5,000,000 bodily injury each occurrence
1,000,000 property damage

104.20 SUBSURFACE INVESTIGATION

Soil borings have been performed at the site of the work. A partial log of the borings is reproduced on the Drawings. The complete report is on file with the Engineer, and may be reviewed by the Bidders or the Contractor at a location designated by the Engineer.

The Engineer makes no representation as to the correctness of the information contained in the boring logs, nor as to the location of the boring holes, nor that the report represents a cross section of the material to be encountered in performing excavation and earthwork on the Project. Any use made of the report by the Bidders or the Contractor is at the sole risk of such bidders or the Contractor who have the responsibility to satisfy themselves independently from other sources regarding the character and amount of rock, gravel, sand, silt, organic materials, groundwater, and all other material to be encountered in the work to be performed.

The use of this information shall be at the Bidders' or the Contractor's discretion. The Bidders or the Contractor shall recognize the fact that the determination of the types and sizes of material was limited by the size of the auger or drill used to drill the hole. Bidders or Contractor shall make whatever other investigations as are necessary in order to determine to their or his satisfaction the conditions that exist.

105.2 PLANS AND SHOP DRAWINGS

Prior to purchase or fabrication, the Contractor shall furnish the Engineer with shop drawings, layout diagrams, manufacturer's catalog data, and detailed information, in sufficient detail to show complete compliance with all specified requirements, covering but not limited to the following items:

1. Detailed sequence of construction
2. Concrete mix designs
3. Precast girders
4. Reinforcing steel
5. Metal fencing
6. Bearing pads
7. Shoring and bracing plans for structure excavation
8. Falsework plans and design calculations
9. Fabricated steel pipe and design data
10. Prestressed concrete cylinder pipe and design data
11. Reinforced concrete pipe and design data
12. Miscellaneous pipe, fittings, and valves
13. Utility protection plans

The number of copies of shop drawings required for approval shall be as follows:

Initial submittal: Three (3) copies. One (1) copy will be returned to the Contractor.

Final submittal: Six (6) copies. Two (2) copies will be returned to the Contractor.

Drawings for shoring and bracing plans for structure excavation and false-work plans shall be prepared by and bear the seal and signature of a licensed Professional Civil or Structural Engineer in the State of Arizona.

When submitted for the Engineer's review, shop drawings shall bear the Contractor's certification that he has reviewed, checked, and approved the shop drawings, and that they are in conformance with the requirements of the Contract Documents. The Engineer will not review any submittals which do not bear the Contractor's certification.

After the review has been completed, the above drawings, lists, samples, design calculations, and other data, shall become a part of the Contract Documents and the fabrications furnished shall conform to the submittal.

Review of material and layout drawings consists of review for general conformity to Plans and Specifications and in no way relieves the Contractor or the supplier from responsibility for the correctness of the drawings.

Deviations or changes from Plans or Specifications must be called out as such and will require review by the Engineer for approval or rejection.

105.5 JOB OFFICE

The Contractor shall provide a job office at the work site to facilitate construction management of the project. One Hundred Twelve (112) square feet of office space, equipped with suitable desk, telephone, chair, plan rack, drafting table, photostatic copier, filing cabinet, and water cooler shall be provided for the use of the Owner's Field Representative throughout the construction of the project.

105.6 COOPERATION WITH UTILITIES

An attempt has been made to determine the location of all underground utilities and drainage pipes, culverts and structures; however, it shall be the Contractor's responsibility to cooperate with the pertinent utility companies so that any obstructing utility installation may be adjusted. Should the Contractor's operations result in damage to any utility, he shall assume full responsibility for such damage. During construction, utilities such as SRP will be relocating utilities within the project work area. The Contractor will coordinate with these utilities as required.

The following phone numbers should put the Contractor in contact with the proper personnel:

Flood Control District..... 262-1501
Salt River Project (Water Operation Support) -
 Tim Phillips..... 236-2956
Salt River Project (Distribution Engineering Dept.) -
 Chuck Hughes..... 236-2090
Salt River Project (Substation Engineering Dept.) -
 Gary Frere..... 236-3154
Location Staking (U.S. West, SRP)..... 263-1100
City of Phoenix - Squaw Peak Water Treatment Plant
Senior Treatment Facilities Supervisor - Tom Martin..... 262-4983
City of Phoenix Streets and Traffic - Marshal Hollen.... 262-6565
City of Phoenix Water and Wastewater - Gerald Arakaki... 261-8229
U.S. West Communications - Curt Sayer..... 831-4777

105.8 CONSTRUCTION STAKES, LINES AND GRADES

The project control lines and benchmark elevation are shown on the drawings and will be established by the Engineer. The Contractor shall establish offset stakes and temporary benchmarks for referencing the designated construction lines and grades. The Contractor shall provide all rough grade, fine grade, and structural reference lines and shall be responsible for their conformance with the Plans and Specifications.

Survey work shall be performed by a qualified and experienced surveyor under the supervision of a licensed land surveyor.

The Contractor shall furnish field books to be used for recording survey data and field notes. These books shall be available for inspection by the Engineer at any time and shall become the property of the Engineer upon completion of the work.

The Engineer reserves the right to make inspections and random checks of any portion of the staking and layout work. If, in the Engineer's opinion, the work is not being performed in a manner that will maintain proper control and accuracy of the work, he will order any or all of the staking and layout work redone at no additional cost.

105.10 INSPECTION OF WORK

Work will be subject to City of Phoenix inspection and acceptance prior to final acceptance by the Engineer.

106 CONTROL OF MATERIALS

SOURCE OF MATERIALS AND QUALITY: The Contractor shall guarantee the construction work for one year against faulty materials, faulty workmanship and failure to meet the requirements of the Specifications. Said guarantee by the Contractor shall not apply to damage caused by earthquakes or other acts of God, land subsidence, or faulty operations or any abuse of the structures by others.

CONSTRUCTION SPECIAL PROVISIONS
CONTRACT NO. FCD 88-40

106.5 CONTRACTOR'S STAGING AREA

The Contractor shall confine the storing of materials and location of temporary facilities to the area shown on the Drawings.

107.2 PERMITS

The Contractor shall be responsible for obtaining all permits and licenses, pay all charges, fees, taxes and give all notices necessary and incidental to the due and lawful prosecution of the work. Permits for earth moving may be obtained from the Bureau of Air Pollution Control, Maricopa County Department of Health Services, 1845 East Roosevelt, telephone number 258-6381.

A no charge permit is required from the City of Phoenix.

A permit from the Salt River Valley Water Users Association for work in their right-of-way will be supplied by the Flood Control District.

108.5 LIMITATION OF OPERATIONS

Should the Contractor or subcontractor elect to perform any work before or after regular working hours, on weekends, or legal holidays, any charges incurred by the District for inspection of the work, surveys, or tests of materials will be deducted from monies due or to become due to the Contractor.

108.9 FAILURE TO COMPLETE ON TIME

The actual cost per calendar day incurred by the District for Consultant Administrative and Inspection Services on this project will be added to the daily charges as indicated by TABLE 108, LIQUIDATED DAMAGES, as shown in the MAG Uniformed Standard Specifications (not in the Phoenix Supplement), and will be deducted from monies due or to become due to the Contractor for each and every calendar day that work shall remain uncompleted after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer. Nothing contained in this provision shall prohibit the District from deducting from monies due or to become due to the Contractor any other costs incurred by the District directly attributable to the delay in completing this Contract.

109 MEASUREMENTS AND PAYMENTS

Under MAG Section 109.5.1 Equipment, the following exception is made:

Unless a prior written agreement has been made, the Maricopa County Flood Control District will not pay move-in/move-out costs and standby equipment rates.

201 CLEARING AND GRUBBING

The work under this item consists of removal and disposal of all trees, stumps, and objectionable materials within the limits of the roadways, access bridges, pipeline relocations and removals, and other areas designated on the Plans. Materials shall be disposed of off-site. Also see Section 205.6 in these Special Provisions. This is not a pay item.

205.6 DISPOSAL OF SURPLUS MATERIAL

All surplus and/or waste material may be disposed of at the Contractor's discretion subject to the following conditions:

- A. If the City landfills are used, the Contractor shall pay the normal dumping fee.
- B. If private property within the City limits is used, the Contractor shall obtain written permission from the property owner and deliver a copy of this agreement to the Engineer prior to any hauling or dumping. All disposal and grading shall be in strict conformance with the City of Phoenix Grading and Drainage Ordinance. The Contractor shall obtain and pay for the necessary permit(s).
- C. If the surplus material is disposed of outside the City limits, the Contractor shall comply with all applicable laws/ordinances of the agency concerned and be responsible for all cost incurred.

No measurement or direct payment will be made for the hauling and disposal of surplus and/or waste material, the cost shall be incidental to the cost of the project.

206 STRUCTURE EXCAVATION AND BACKFILL

Structure excavation and backfill shall conform to Section 206 of the Uniform Standard Specifications.

Structure backfill behind the abutments, wing walls and pipe supports shall be compacted to not less than 100 percent density when tested and determined by AASHTO T-99 and T-191, or ASTM D-2922 and D-3017. When AASHTO T-99, method A or B, and T-191 are used for density determination, MAG Detail 190 will be used for rock correction.

Payment for all work under this section shall be at the Contract unit price per cubic yard for Item 206-1 - Structural Excavation Bridge and Pipe Crossings and Item 206-2 - Structural Backfill Bridge and Pipe Crossings.

206.1

EXCAVATION SUPPORT

- A. General: Contractor shall support the faces of excavations and shall protect structures and improvements in the vicinity of excavations from damage due to settlement of soils.
1. The provisions specified hereunder shall be understood:
 - a. to complement, and not to substitute or diminish, the obligations of Contractor for the furnishing of a safe place of work pursuant to the provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for the protection of the work, structures, and other improvements.
 - b. to represent a minimum requirement
 - 1) for the number and types of means needed to maintain soil stability,
 - 2) for the strength of such required means, and
 - 3) for the methods and frequency of maintenance and observation of the means used for maintaining soil stability.
 2. Excavation support shall include sheeting, shoring, bracing, sloping, and other means and procedures, such as routing and disposing of surface runoff, required to maintain the stability of soils.
- B. Contractor shall provide excavation support in trenches for the protection of workers from the hazard of caving ground.
- C. Excavation supports shall be provided:
1. Where, as a result of excavation work and an analysis performed pursuant to general engineering design practice, as defined hereinafter,
 - a. the excavated face or surrounding soil mass may be subject to slides, caving, or other type of failure, or
 - b. the stability and integrity of structures and other improvements may be compromised by settlement or shifting of soils.
 2. For trenches five feet and deeper.

D. References:

1. American Institute of Steel Construction, Inc., Manual of Steel Construction, herein referenced as the Steel Manual.
2. International Conference of Building Officials, Uniform Building Code, herein referenced as the UBC.

E. Definitions: As used under this title of Excavation Support, general engineering design practice shall be understood to mean the general engineering design practice in the area of the Project performed in accordance with recent engineering literature on the subject of excavation support.

1. Where general engineering design practice is specified it shall be understood that the design shall be performed, and the drawings and calculations shall be signed, by a civil or structural engineer registered in the state where the Project is located.
 - a. The design calculations shall disclose clearly the assumptions made, the criteria followed, and the stress values used for the various materials.
 - b. Where requested by Engineer, Contractor shall furnish acceptable references substantiating the appropriateness of the design assumptions, criteria, and stress values.

F. Submittals:

1. For trench excavation, Contractor shall submit, in advance of excavation of trenches 5 feet or more in depth, detailed plans showing the design of excavation support for worker protection.
2. For excavations other than trenches, Contractor shall submit:
 - a. An analysis performed pursuant to general engineering design practice, as specified hereinbefore, identifying the conditions under which excavation support will be required. This analysis shall be submitted in advance of and shall cover:
 - 1) Excavations 2 feet or more in depth adjacent to structures, and
 - 2) Excavations 5 feet or more in depth at other locations.

b. For excavations that will require excavation support, in accordance with the determination made under the preceding subparagraph a., Contractor shall submit excavation support design and details pursuant to general engineering design practice, as specified hereinbefore.

1) The same procedure shall be followed for subsequent changes to the excavation support design.

G. Design Criteria:

1. Excavation support shall be designed in accordance with general engineering design practice.
2. Steel members shall be designed in accordance with the Steel Manual.
3. Design involving materials other than steel shall be in accordance with the UBC.
4. Excavation support shall be designed in accordance with soil characteristics and design recommendations contained in a written report issued and signed by a civil or soil engineer registered in the state where the Project is located.
 - a. A copy of the written report shall be available at the site of the Project for Engineer's review.
 - b. The civil or soil engineer shall be retained by Contractor.
5. Where Contractor elects to design excavation support allowing materials to bear stresses higher than those prescribed in the referenced publications, the increase in such stresses shall not exceed 10 percent of the value of the prescribed stresses.

H. Performance Requirements: Appropriate design and procedures for construction and maintenance shall be used to minimize settlement of the supported ground and to prevent damage to existing structures and other improvements. Such design and procedures shall include:

1. Using stiff support systems.
2. Following an appropriate construction sequence.
3. Preventing soil loss through or under the support system.

- a. The support system shall be tight enough to prevent loss of soil and shall be extended deep enough to prevent heave or flow of soils from the supported soil mass into the excavation.
 - 4. Providing surface runoff routing and discharge away from the excavations.
 - 5. Not anchoring the support system to structures and other improvements.
 - 6. Not applying support system loads to structures and other improvements.
 - 7. Not changing existing soil loading on structures and other improvements.
- I. Installation:
- 1. Excavation support shall be installed as indicated in the approved submittals.
 - 2. Excavation, including trenching, shall not begin until the excavation support submittals have been approved by the Engineer and until the materials necessary for the installation are on site.
- J. Maintenance:
- 1. Where loss of soil occurs, Contractor shall plug the gap in the support system and shall replace the lost soil with suitable fill material.

211 FILL CONSTRUCTION

Fill construction shall consist of raising the existing grades to the roadway subgrades and to provide a minimum of 3 feet of cover over new pipelines, as shown on the Plans and in accordance with Section 211 of the Uniform Standard Specifications.

Payment for all work under this section shall be at the contract unit price per cubic yard for Item 211-1 - Fill Construction.

301 SUBGRADE PREPARATION

Subgrade preparation shall consist of shaping the roadway subgrades to the grades and cross sections for the new roadways and bridge approach slabs as shown on the Plans and in accordance with Section 301 of the Uniform Standard Specifications.

This item shall also include all work necessary for the construction of ditches, any excavation, filling, grading, shaping and miscellaneous grading work between the back of curb or edge of pavement and the right-of-way or construction easement.

Width of measurement for payment along new roads will be to outside edge of aggregate base course as shown on the Plans.

Payment for all work under this section shall be at the Contract unit price per square yard bid for Item 301-1 - Subgrade Preparation.

310 UNTREATED BASE

Item 310 - Aggregate Base Course shall conform in their entirety to the requirements of Section 310 of the Uniform Standard Specifications. Aggregate base shall be crushed in accordance with Section 702.2.

The Contractor will be required to furnish the Engineer certified weight tickets covering all of the aggregate base placed on the project. Final pay quantities will be based upon the scale tickets accepted by the Engineer.

321 ASPHALT CONCRETE PAVEMENT

Asphalt concrete pavement shall consist of furnishing and placing a plant-mixed asphalt concrete road surfacing material to the compacted thickness shown on the Plans and in accordance with Section 321 of the Uniform Standard Specifications.

The mineral aggregate shall meet the grading requirements within the range of the specified tolerances for Mix-Designation A-1 1/2, or C-3/4 in accordance with Section 710 of the Uniform Standard Specifications and the City of Phoenix Supplement to the Uniform Standard Specifications.

The Contractor shall furnish certified weight tickets covering all plant-mixed asphalt concrete placed on the project.

New pavement shall be constructed to the lines and grades as shown on the Plans. Where the grades require overlay construction, the existing asphaltic or portland cement concrete pavement shall be prime coated as specified in Section 315.

Payment for Item 321-1 will be made at the Contract unit price bid per ton.

336 PAVEMENT REPLACEMENT OR RESTORATION

Except as noted on the Plans, all pavement removal and replacement shall be per MAG Section 336. New pavement shall be the same thickness as adjacent pavement.

MAG Section 336, Section 336.2.2; second and third paragraphs, are deleted. All pavement replacement shall be Type "A".

350 REMOVAL OF EXISTING IMPROVEMENTS

Removal of existing pipelines, pavement, duct banks, and structures shall be as indicated on the Plans.

Temporary removed sections of existing fence shall be stored for later reinstallation after relocated pipelines are in place.

401 TRAFFIC CONTROL

Attention is directed to Section 401.2, Traffic Control Devices, of the MAG Standard Specifications, and to the City of Phoenix Traffic Barricade Manual. This is not a pay item.

415 FLEXIBLE METAL GUARDRAILS

Item 415 - Flexible Metal Guardrails shall conform in their entirety to the requirements of Section 415 of the Uniform Standard Specifications.

420 CHAIN LINK FENCES

Item 420 - Chain Link Fence shall conform in their entirety to the requirements of Section 420 of the Uniform Standard Specifications.

502 DRILLED SHAFT FOUNDATIONS

DESCRIPTION: The work under this section consists of furnishing all materials and equipment necessary to construct reinforced concrete columns formed within a drilled excavation in reasonably close conformity with the details, dimensions, and locations indicated on the Project Plans and the requirements of these Special Provisions.

If a rock socket or a belled footing is required or if a test drilled shaft is required, the Project Plans will so specify.

GENERAL REQUIREMENTS: Prior to constructing any drilled shafts, the Contractor shall submit to the Engineer a list of all major equipment, with respective capacities, that will be used to construct the drilled shafts and the proposed construction procedure. The submission shall indicate, in detail, the techniques to be used in drilling the shaft and inspecting the completed excavation and reinforcing and concreting the drilled shafts.

The Engineer will review the submission. If at any time during the construction of drilled shafts, the Engineer determines that the equipment, materials or procedures, either singly or in combination, are such that defects in the work may occur, the Engineer may stop the work until appropriate changes are made by the Contractor. In no case shall the Contractor be relieved of his responsibility for constructing acceptable drilled shafts.

After constructing one or more drilled shafts, the Contractor may make minor modifications to the equipment, materials or procedures, either singly or in combination, and shall advise the Engineer of the changes in writing. The Engineer will review the proposal and may require the Contractor to construct a test drilled shaft in order to test the proposed changes prior to constructing any additional bridge foundation drilled shafts.

An acceptable bridge foundation drilled shaft shall be constructed prior to the construction of any other drilled shaft for the bridge foundation.

The decision of the Engineer as to the acceptability of completed drilled shafts is final.

MATERIALS:

Concrete: Concrete shall be Class AA conforming to the requirements of Section 725 for the strength of portland cement concrete indicated on the Project Plans. Where concrete is placed in shafts containing bentonite slurry or water, the cement content of the concrete shall be between 658 and 752 pounds per cubic yard and the size of the coarse aggregate shall not exceed one inch. Water reducing and air entraining agents may be used.

Reinforcing Steel: Reinforcing steel shall conform to the requirements of Section 727. Where indicated on the Plans, steel reinforcement shall be Grade 60. Reinforcing steel to be welded shall meet the requirements of ASTM A 706, Grade 60.

Metal Casing: Casing shall be of unit or sectional construction and shall prevent seepage of water. Casing shall be of sufficient strength to withstand handling stresses, the pressure of concrete and of the surrounding earth. Casings are not required except as a temporary measure if caving of the shaft should occur.

Shaft Forms: If the size of the shafts adjacent to the channel cannot be maintained within 2 inches of the shaft diameter, as indicated on the Plans, for the depth of the proposed channel, or if over drilling will narrow the channel width, sonotube or an approved method shall be used to control the shaft diameter and location indicated on the Plans.

CONSTRUCTION REQUIREMENTS:

Excavation: The Contractor shall perform all excavation required for the shafts, rock sockets or belled footings, through whatever substances encountered, to the dimensions and elevations indicated on the Project Plans or required by the site conditions. Unless otherwise indicated on the Project Plans, the maximum deviation from plumb shall be not more than one inch in ten feet and the maximum variation of the center axis of any shaft at the top shall be three inches from its Project Plan location. When bells or rock sockets are required, they shall be excavated so as to form a bearing area of the size and shape indicated on the Project Plans.

The anticipated subsurface conditions and depths where satisfactory bearing material may be encountered are indicated on the Project Plans; however, no warranty of the subsurface conditions and depths where satisfactory bearing material may be encountered shall be inferred.

The bottom elevation of any drilled shaft may be raised or lowered from that indicated on the Project Plans as ordered by the Engineer. No reinforcing steel or concrete shall be placed in a shaft until the final elevation has been determined.

Excavation of adjacent shafts at any pier or abutment will not be permitted until 48 hours after the adjacent shaft has been concreted.

The Contractor shall protect the shaft from caving in at the surface either by constructing a concrete slab or by placing a temporary casing or by other methods as accepted by the Engineer. The Contractor shall either drill or form a circular opening at the center of the slab. The slab shall be broken up and removed at the completion of the drilled shaft construction. If a casing is used, it shall be removed after the concreting of the shaft is completed and while the concrete is still fluid. Casing shall not be left in place except as indicated on the Project Plans or as accepted by the Engineer.

Casing specified on the Project Plans or accepted by the Engineer to remain in place shall be installed in such a manner that there will be no voids between the earth and the casing.

When caving conditions are encountered, drilling shall cease until modifications to the equipment, materials or procedures are made that will prevent such caving. If a steel casing is used, it shall be clean and shall extend to the top of the shaft. The inside diameter of the casing shall not be less than the specified size of the drilled shaft.

Material excavated from shafts and bells and not used elsewhere on the project shall be disposed of as accepted by the Engineer.

When the Project Plans indicate that shafts are to be drilled within embankments, the embankments shall be constructed as indicated on the Project Plans and thoroughly compacted in accordance with the requirements of Section 206 prior to drilling, except as otherwise accepted by the Engineer.

Open excavations that are deemed to be potentially hazardous by the Engineer shall be covered at the end of each shift in a manner accepted by the Engineer.

Reinforcing Steel: The reinforcing steel cage shall consist of the longitudinal bar and spiral hoop or lateral tie reinforcement. The cage shall be completely assembled and placed into the shaft as a unit.

Unless otherwise indicated on the Project Plans, or accepted by the Engineer, splicing of reinforcing steel will not be permitted. Lap splices shall be in accordance with the details indicated on the Project Plans or as accepted by the Engineer and only at locations acceptable to the Engineer.

When welding of reinforcing steel is permitted on the Project Plans to facilitate installation of the cage, not more than one splice per bar will be permitted. Splices in adjacent bars shall be staggered not less than four feet. Splices shall be direct butt welded in accordance with the requirements of American Welding Society D1.4; mechanical butt splices of the exothermic process, or threaded bar splices, as accepted by the Engineer. All welded splices shall be radiograph inspected in accordance with the requirements of American Welding Society D1.4, Section 4.4. Mechanical butt splices and threaded splices shall develop the full tensile yield strength of the bars. The test method shall be as accepted by the Engineer.

The reinforcing steel cage shall not be placed until immediately before concreting operations are to be started and shall be placed in accordance with the details indicated on the Project Plans.

The cage shall be adequately supported and anchored from the top to prevent movement during the concrete placement and for at least four hours thereafter. The exact length of time will be determined by the Engineer. The support shall be concentric and shall support at least one-half of the vertical bars. Spacers shall be at sufficient intervals along the shaft to maintain minimum concrete cover for the entire length of the drilled shaft. The type of spacer used shall be accepted by the Engineer.

If the shaft is deepened and the Project Plans indicate full depth reinforcement, the bars in the lower portion of the drilled shaft shall be extended accordingly, as directed by the Engineer, to the bottom of the shaft. These bars shall be lap spliced, spliced by butt welding or by other connecting procedures accepted by the Engineer to the proper length in accordance with the requirements of Section 505.5. If the Project Plans indicate spiral or tie reinforcement for the full depth of the drilled shaft, the spiral or the reinforcement shall also be extended to the bottom of the shaft as directed by the Engineer.

CONCRETE:

General: Concrete shall be placed as soon as possible after completion of the shaft and the placement of the reinforcing steel cage. Any sloughage or other loose material shall be machine cleaned from the shaft prior to placing reinforcing steel and concrete. An accumulation of loose soils, muck, etc., at the bottom of the shaft will not be allowed at the time of placing steel or concrete. A flight auger shall not be used for cleaning purposes.

Concrete placement shall be continuous in the shaft to the top elevations or to construction joint indicated on the Project Plans and shall be in accordance with the requirements of Section 505.5 and as specified herein. Concrete in the drilled shafts shall be consolidated by vibration.

Prior to the placing of concrete, the Contractor shall have made all the necessary arrangements to maintain the uninterrupted delivery of concrete so that each drilled shaft will be constructed without cold joints.

The Contractor shall exercise care so that no damage to a completed drilled shaft will occur. The Contractor shall not begin construction of the footings, formed columns or cap beams or remove the concrete pad until at least 48 hours after the concreting of the shaft is completed for the respective pier or abutment drilled shaft.

Placement in Dry Excavations: Concrete shall be placed through a suitable tube or tremie to prevent segregation of materials.

Concrete may be placed by the free-fall method provided that water is not standing in the bottom of the shaft and that the fall does not exceed eight feet. The delivery chute shall be positioned so that the concrete does not strike the sides of the shaft or the reinforcing steel.

Casing Removal: During removal of any casing, a sufficient head of not less than five feet of fluid concrete shall be maintained above the bottom of the casing except at the top of the shaft. All contaminated concrete below the top of the drilled shaft shall be removed.

If the removal of the casing causes an upward movement of the concrete and/or reinforcing steel cage of one inch or less, the casing may continue to be pulled provided no further movement occurs and if the concrete is vibrated or rodded to reconsolidate the concrete. Vibration or rodding of the concrete shall not be used to attempt to break the casing loose for extraction.

If the upward movement is greater than one inch, the casing shall be left in place as a permanent sleeve at the Contractor's expense. A load test may be required by the Engineer to determine the adequacy and acceptability of the drilled shaft.

TEST DRILLED SHAFT: Unless otherwise directed by the Engineer, a test drilled shaft is not required. The Contractor shall construct one full-depth drilled shaft of the size and to the tip elevation specified on the Project Plans in accordance with the submission hereinbefore described under "General Requirements" in order that the proposed equipment, materials and procedures may be tested and to allow the Engineer to determine the extent and kinds of inspection, all as necessary to maintain the structural integrity of the bridge foundation.

The test drilled shaft shall be constructed at the site of the work at the exact location specified by the Engineer. It shall be identical to the details indicated on the Project Plans except that bars for column reinforcing steel above the top of the drilled shaft will not be required.

If a completed test drilled shaft upon inspection and testing is deemed by the Engineer to be unacceptable, another full depth test drilled shaft shall be constructed.

Any unacceptable drilled shafts shall be backfilled as directed by the Engineer.

In each test drilled shaft, three voids shall be simulated at locations specified by the Engineer. The voids shall be simulated by affixing to the reinforcing steel cage a hollow, sealed device such as a five-gallon pail, a bundle of capped PVC, or other device as accepted by the Engineer. After the gamma ray logging inspection has been completed, the Contractor shall expose the test drilled shaft by excavating to a sufficient depth above the water table elevation in order that the Engineer may determine the acceptability of the test drilled shaft.

INSPECTION AND TESTS: Continuous observations of the construction of drilled shaft foundations should be carried out by a representative of the Geotechnical Engineer. He should verify proper diameter of the shaft, depth and cleaning, and should also verify the nature of materials encountered in the shaft excavations. Concrete placement should be continuously observed to see that it meets requirements. A quality assurance report should be submitted on each shaft stating, in writing, that all details have been observed and meet the requirements. After completion of a shaft and prior to placement of the reinforcing steel cage and concrete, the shaft will be inspected by the Engineer. The Contractor shall provide suitable equipment for the Engineer to inspect the completed excavation.

DRILLED SHAFT REPAIR: If after inspection the Engineer determines that the integrity of the bridge foundation has been compromised, the Engineer will order the Contractor to make such repairs as are deemed necessary by the Engineer.

METHOD OF MEASUREMENT: Drilled shafts will be measured by the linear foot. Measurement will be made from the top of the accepted drilled shaft to the bottom, as indicated on the Project Plans or as directed by the Engineer. Rock sockets will be considered as being part of the shaft for measurement purposes.

BASIS OF PAYMENT: The accepted quantities of drilled shafts, including test drilled shafts, if required, measured as provided above, will be paid for at the Contract unit price per linear foot for Item 502-1, Drilled Shaft Foundation. The price paid shall be for drilled shafts, complete in place, including excavation, drilling slurry, metal casing, steel reinforcing, portland cement concrete, concrete slabs, and any needed forming, curing and finishing. No additional payment will be made for belled sections or for metal casing that is to remain in place.

The Contract unit price shall also include the cost of exposing, by excavation, the upper length of the test drilled shafts, the drilling and/or backfilling of any additional shafts and the construction of any additional test drilled shafts.

The Contract unit price shall also include the cost of the core drilling or exposing of concrete and the subsequent repair of drilled shafts as hereinbefore specified under "Drilled Shaft Repairs" for drilled shafts which are deemed to be unacceptable.

The Contract unit price shall also include the cost of furnishing all materials, equipment and labor necessary for the splicing of reinforcing steel and for the radiographic testing of welds and the testing of butt splices and threaded splices.

If the Contractor is ordered by the Engineer to core drill or otherwise expose the drilled shaft for inspection and no voids, unconsolidated concrete or other condition that will compromise the integrity of the bridge foundation is determined by the Engineer to exist, the cost of such work and the cost of the subsequent repairs will be paid for in accordance with the requirements of ADOT Subsection 109.04.

No measurement or direct payment will be made for the reinforcing steel extending from the top of the drilled shaft foundation into the footing, the cost being considered as included in the cost of the respective drilled shaft foundation.

When load tests are required by the Engineer to determine the adequacy and acceptability of drilled shafts, payment for load tests for drilled shafts determined to be adequate and acceptable will be made in accordance with the provisions of ADOT Subsection 109.04.

Load tests for drilled shafts determined to be inadequate and unacceptable will be at the Contractor's expense.

505 CONCRETE BRIDGE STRUCTURES

The work under this section shall consist of furnishing all labor, materials and equipment for the construction of the cast-in-place concrete portions of the bridge structures, including the approach slabs in accordance with the Plans and Section 505 of the Uniform Standard Specification, except as specified in the Construction Special Provisions.

GENERAL: It shall be the Contractor's responsibility to protect the structure and construction site from damage that may occur during the construction period and until final acceptance of the completed bridge by the Flood Control District.

Upon completion of the construction, the Contractor shall clear the work area of all debris.

The installation of any necessary conduits, brackets, or piping, or any other facility or work which may be performed for the accommodation of any utility, other than as indicated on the Plans, shall be paid for by the utility owner. The Contractor shall make all arrangements that may be necessary for the construction and any financial agreement shall be solely between the Contractor and the utility owner.

Concrete shall have a compressive strength not less than that indicated on the Project Plans. Unless otherwise indicated on the Project Plans, the (f'c) of concrete shall be the required 28-day compressive strength.

The coarse aggregate size designation for concrete shall be chosen by the Contractor and approved by the Engineer and shall conform to the size designation and grading requirements of AASHTO M 43. In choosing the size designation, the maximum size of coarse aggregate shall not be larger than 1/5 of the narrowest dimension between sides of adjacent forms, or 2/3 of the minimum clear spacing between reinforcing bars, or 1/3 the depth of the slab, whichever is least.

The proposed slump shall be chosen by the Contractor. Concrete at the proposed slumps shall be sufficiently workable to allow proper placement without harmful segregation, bleeding, or incomplete consolidation.

Air-entraining admixtures will be required for all classes of concrete. The amount of entrained air in the concrete mixture shall not be less than four percent nor more than seven percent by volume.

Unless specifically required, water reducing admixtures may be used at the option of the Contractor.

At least two weeks prior to the appropriate concreting operation, the Contractor shall furnish a mix design for each strength of concrete for review and approval. More than one mix design for each strength of concrete may be submitted for approval, providing specific items and locations of intended uses accompany the mix design. The Contractor shall substantiate each mix design by furnishing test data and providing all details of the mixtures proposed for use.

The complete solid volume mix designs submitted for approval shall include all weights and volumes of all ingredients. The brand, type, and source of hydraulic cement and admixtures, the coarse aggregate size number designation, source of aggregates, the specific gravities of all ingredients, the proposed slump, a code number to identify the mix design, and the intended use of each mix design shall be an integral part of each mix design.

No changes in the approved mix designs or code numbers shall be made by the Contractor except by the approval of the Engineer. A new mix design shall be submitted for approval any time the Contractor requests a change in materials or proportioning of the materials from that given in each approved mix design. In no case shall the approval of a mix design relieve the Contractor of the responsibility for the results obtained by the use of such approved mix design.

Mix designs from previous or concurrent projects may be submitted for approval. The Engineer may waive trial batches at any time.

The Contractor may obtain concrete for each strength of concrete from an approved commercial source.

For each strength of concrete, the Contractor shall furnish an invoice for each batch of concrete. The minimum items required of each invoice shall be the mix design code number, date, time batched, truck identification or number, and name of identification of batch plant.

Testing for consistency shall be in accordance with the requirements of AASHTO T 119 to determine the consistency in slump. The Contractor shall be responsible for furnishing concrete at the slump shown on the approved mix designs with a permissible variation of ± 1 inch. Concrete that fails to conform to the consistency requirements will be rejected.

TESTS ON FINISHED STRUCTURES:

Surface Texture: The grooves for decks exposed directly to traffic shall be not less than 0.08 of an inch nor more than 0.13 of an inch wide and shall be not less than 0.09 of an inch nor more than 0.20 of an inch in depth. The textured groove depth will be measured in accordance with the requirements of Arizona Test Method 310. The center-to-center spacing of the grooves shall be 0.75 of an inch. The maximum allowable deviation from 0.75 of an inch shall be 0.25 of any inch.

DIMENSIONAL TOLERANCES: Construction dimensional tolerances shall be in accordance with Section 601-4, Concrete Structures, Tests on Finished Structures, of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 1987 (revised to date).

REINFORCING STEEL: Reinforcing steel shall be furnished in the sizes, shapes, and lengths indicated on the Plans and in conformance with the requirements of these Special Provisions. Certificates of Compliance conforming to the requirements of MAG Subsection 106.2 shall be submitted.

When reinforcing steel is delivered to the site of the work, the Contractor shall furnish the Engineer with three copies of all shipping documents. Each shipping document shall show the sizes, lengths and weights of the reinforcing steel separately for each structure.

Steel bars used as reinforcement in concrete shall be deformed and shall conform to the requirements of ASTM A 615, Grade 60.

Shop drawings and lists showing the bending of reinforcement bars shall be submitted by the Contractor to the Engineer for approval, but such approval shall not relieve the Contractor of responsibility for the correctness of such drawings and lists.

Any discrepancy or error found by the Contractor in checking a bending diagram indicated on the Project Plans, or in preparing shop drawings or lists, shall be reported immediately to the Engineer, and the discrepancy or error shall be corrected in advance of fabrication and delivery of materials.

When bending is required, it shall be done without the use of heat, and bars having cracks or splits at the bends will be rejected.

Reinforcement shall be accurately fabricated and placed as indicated on the Plans and shall be firmly held in place by wire ties at all intersections and splices with 16 gauge or heavier tie wire and by using precast mortar blocks or ferrous metal chairs, spacers, metal hangars, supporting wires or other approved supports. Where reinforcement spacing is less than 12 inches in each direction, alternate intersections may be tied. Tack welding or reinforcement will not be permitted unless approved in writing by the Engineer.

Distances from the forms shall be maintained so that the reinforcement does not vary from the position indicated on the Plans by more than 1/4 inch. Reinforcement in any member shall be placed, inspected and approved before any concrete is placed.

All reinforcement shall be furnished in the full lengths indicated on the Project Plans. Splicing of bars, except as indicated on the Plans, will not be permitted without the Engineer's approval. Splices shall be staggered as far as possible. The type and method of splices or connections shall be approved by the Engineer.

In lapped splices, the bars shall be placed in contact with one another and wired together in such a manner as to maintain a clearance of not less than the minimum clear distance to other bars and the minimum distance to the surface of the concrete, as specified in the AASHTO Standard Specifications for Highway Bridges. Lap lengths shall be as indicated on the Plans.

Structural steel items embedded in the concrete are incidental to concrete unit prices.

PAYMENT: Payment for concrete bridge structures will be made in accordance with the Uniform Standard Specifications (MAG) and the following.

Payment for cast-in-place concrete bridge work except for steel reinforcement and PVC pipe will be made at the unit price bid for Item 505-1, Structural Concrete.

Payment for steel reinforcement for concrete will be made at the unit price bid for Item 505-2, Steel Reinforcement.

506.1 PRECAST PRESTRESSED CONCRETE BRIDGE MEMBER

The work under this section shall consist of repairing, transporting, and erecting the bridge members as indicated on the Plans. Girders are stored in the vicinity of 35th Avenue and Pinnacle Peak Road.

The elastomeric bearing pads shall meet the requirements of Section 25 - Elastomeric Bearings of the AASHTO Standard Specifications for Highway Bridges dated 1983 (revised to date).

No separate payment will be made for the elastomeric bearing pads, structural steel, or anchor bolts, necessary to the transporting and erecting of the bridge members complete-in-place.

Payment will be made at the unit price bid for Item 506-1, Transport, Erect and Repair Concrete Bridge Members.

506.2 PRESTRESSING CONCRETE

506.2.1 DESCRIPTION

The work under this section shall consist of prestressing precast and cast-in-place concrete by furnishing, placing and tensioning of prestressing steel in accordance with the details shown on the project plans, and the requirements of these Specifications.

The work under this section shall also include the furnishing and installation of any appurtenant items necessary for the particular prestressing system to be used, including but not limited to ducts, anchorage assemblies and grout used for pressure grouting ducts.

Prestressing shall be performed by the post-tensioning method for cast-in-place concrete structures.

506.2.2 MATERIALS

506.2.2.1 REINFORCING STEEL AND PRESTRESSING STEEL

Materials furnished for reinforcing steel shall conform to the requirements of Section 727 of the Uniform Standard Specifications.

Prestressing steel shall be high-tensile steel wire, high-tensile seven-wire strand or high-tensile alloy bars, as shown on the project plans.

High-tensile steel wire shall conform to the requirements of AASHTO M 204.

High-tensile seven-wire strand shall conform to the requirements of AASHTO M 203 for Grade 270. In addition to the 0.5 inch diameter prestressing steel shown on the project plans, 0.6 inch diameter seven-wire strand may be used for cast-in-place prestressed structures. The diameter of the center wire shall be at least 0.0035 inch larger than the diameter of the outer wire and the strand shall be Grade 270.

High-tensile alloy bars shall conform to the requirements of AASHTO M 275.

All prestressing steel shall be satisfactorily protected from damage by abrasion, moisture, rust, or corrosion and shall be free of dirt, rust, oil, grease, or other deleterious substances when installed and when tensioned.

506.2.2.2 DUCTS

Duct enclosures for prestressing steel shall be rigid galvanized ferrous metal.

506.2.2.3 GROUT

Cement grout for bonding prestressing tendons shall consist of not more than five gallons of water to 94 pounds of portland cement and may contain an admixture if approved by the Engineer. No admixtures containing chlorides or nitrates shall be used.

Portland cement shall be Type II conforming to the requirements of Subsection 725.2.

Water shall conform to the requirements of Subsection 725.5.

506.2.2.4 STRUCTURAL STEEL

Material furnished for structural steel shall conform to the following requirements:

Structural carbon steel shall conform to the requirements of AASHTO M 183 (ASTM A36).

High strength low-alloy structural manganese vanadium steel shall conform to the requirements of AASHTO M 188 (ASTM A 441).

High strength low-alloy structural steel up to four inches thick with 50,000 psi minimum-yield point shall conform to the requirements of AASHTO M 222 (ASTM A 588).

506.2.2.5 PORTLAND CEMENT CONCRETE

Portland cement concrete shall conform to the requirements of Section 725 for the class and strength of concrete shown on the project plans.

506.2.3 CONSTRUCTION REQUIREMENTS

506.2.3.1 SHOP DRAWINGS

Shop drawings of the proposed prestressing system shall be submitted in accordance with the requirements of Subsection 105.2.

The drawings shall show the method and procedure of jacking and the type, size, and properties of the strands and number of strands per tendon and of the anchorage assembly. The calculations shall show the elongation of the strands at the time of jacking and the initial forces in the strands and the working forces. The stresses in the anchorages and distribution plates shall be calculated. The sizes, shapes, dimensions, and concrete cover shall be shown for the ducts and reinforcing steel, including any reinforcing steel to be relocated and any other embedded items.

506.2.3.2 APPROVAL OF PRESTRESSING SYSTEMS

The approval of any prestressing systems for cast-in-place structures not approved by the California Department of Transportation will be contingent on prequalification testing by the Contractor, at his expense, of complete tendon assemblies as proposed for use and the submittal of written information as requested by the Engineer.

The Contractor shall provide a calibration of the post-tensioning jacking system and shall provide the appropriate control settings for a testing lab's transducer, electrohydraulic load cell system by testing the jacking system in a manner that has been pre-approved by the Engineer. In addition, a graph shall be prepared showing the gauge pressure in pounds per square inch and force in thousands of pounds plotted through the whole range of the post-tensioning calibration. Not more than two years shall elapse between any jack calibration.

Prior to casting any concrete to be prestressed, the Contractor shall submit to the Engineer for approval complete details of the method, materials, and equipment he proposes to use in the prestressing operations. Such details shall outline the method and sequence of jacking, complete details of the prestressing steel and anchoring devices proposed for use, anchoring stresses, type of enclosures, and all other data pertaining to the prestressing operations.

Any deviation from the approved materials and details will not be permitted unless new details are submitted by the Contractor and approved in advance of use.

The approval of any proposed method, material or equipment shall not operate to relieve the Contractor in any respect of full responsibility for successfully completing the prestressing in accordance with details shown on the project plans and the requirements of these Specifications.

506.2.3.3 SAMPLING AND TESTING

Sampling and testing shall conform to the requirements of AASHTO M 203, AASHTO M 204 and as specified herein.

Samples from each size and each heat of prestressing bars, from each manufactured reel of prestressing steel strand, from each coil of prestressing wire and from each lot of anchorage assemblies and bar couplers to be used shall be furnished for testing. With each sample of prestressing steel wires, bars or strands furnished for testing, there shall be submitted a Certificate of Analysis, conforming to the requirements of Subsection 106.2, stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.

All materials for testing shall be furnished by the Contractor at his expense. The Contractor shall have no claim for additional compensation in the event his work is delayed awaiting approval of the materials furnished for testing.

All bars of each size from each mill heat, all wire from each coil, and all strand from each manufactured reel to be shipped to the site shall be assigned an individual lot number and shall be tagged in such a manner that each lot can be accurately identified at the job site. Each lot of anchorage assemblies and bar couplers to be installed at the site shall be likewise identified. All unidentified prestressing steel, anchorage assemblies or bar couplers recovered at the site will be rejected.

506.2.3.4 ANCHORAGE AND DISTRIBUTION

All post-tensioned prestressing steel shall be secured at the ends by means of approved permanent type anchoring devices.

All anchorage devices for post-tensioning shall hold the prestressing steel at a load producing a stress of not less than 95 percent of the guaranteed minimum tensile strength of the prestressing steel.

The load from the anchoring device shall be distributed to the concrete by means of approved devices that will effectively distribute the load to the concrete.

The load distribution devices shall conform to the following minimum requirements:

The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 pounds per square inch.

Bending stresses in the plates or assemblies induced by the jacking of the prestressing steel shall not exceed the yield point of the material or cause visible distortion in the anchorage plate when 100 percent of the ultimate force is applied as determined by the Engineer.

506.2.3.5 DUCT INSTALLATION

Duct enclosures for prestressing steel shall be mortar-tight and accurately placed at the locations shown on the project plans or approved by the Engineer.

Ducts shall be fabricated with either welded or interlocked seams. Galvanizing of the welded seam will not be required. Ducts shall have sufficient strength to maintain their correct alignment during placing of concrete. Joints between sections of duct shall be positive metallic connections which do not result in angle changes at the joints. Water-proof tape shall be used at all connections. Transition couplings connecting ducts to anchoring devices need not be galvanized.

All ducts or anchorage assemblies shall be provided with pipes or other suitable connections for the injection of grout after prestressing.

Ducts for prestressing steel shall be securely fastened in place to prevent movement and displacement during concreting.

After installation in the forms, the ends of ducts shall at all times be covered as necessary to prevent the entry of water or debris. If prestressing steel is to be installed after the concrete has been placed, the Contractor shall demonstrate to the satisfaction of the Engineer that the ducts are free of water and debris immediately prior to installation of the steel.

Prior to placing forms for closing slabs of box girder cells, the Contractor shall demonstrate to the satisfaction of the Engineer that all ducts are unobstructed and if the prestressing reinforcement has been placed, that the steel is free and unbonded in the duct.

Prior to placing the forms for closing slabs of box girder cells, the Contractor shall demonstrate to the Engineer, by aerostatic and/or hydrostatic tests, that the duct system, except those ducts not completely encased by concrete, will not permit leakage into the box girder cells. Such tests shall be performed with a minimum pressure up to 50 pounds per square inch. Once the testing pressure is attained, the mechanical shut-off valve shall be closed for a period not less than five minutes. Ducts not completely encased by concrete shall have the exposed areas sealed with an epoxy compound and then pressure tested to 20 pounds per square inch for one minute. All leaks shall be repaired and the ducts retested prior to placing the forms. After completing each aerostatic and/or hydrostatic test, the ducts shall be blown dry with oil free compressed air.

506.2.3.6 PRESTRESSING

A. General:

Unless otherwise shown on the project plans, the average working force in the prestressing steel shall not exceed 60 percent of its specified minimum ultimate tensile strength. The prestressing steel shall be anchored at an initial force (initial stress) that will result in the ultimate retention of working forces of not less than those shown on the project plans but in no case shall the average initial force exceed 70 percent of the minimum ultimate tensile strength of the prestressing steel. In no case shall the jacking force exceed 75 percent of the minimum ultimate tensile strength of the prestressing steel.

Working force will be considered as the force remaining in the prestressing steel after all losses, including creep and shrinkage of concrete elastic compression of concrete, losses in prestressing steel due to sequence of stressing, friction, and all other losses peculiar to the method or system of prestressing have taken place or have been provided for.

All prestressing steel shall be tensioned with hydraulic jacks so that the force in the prestressing steel shall not be less than the value shown on the project plans. Each jack used shall be equipped with

either a pressure gauge or a load cell to determine the jacking force. All jacks and gauges shall be calibrated as a unit and shall be accompanied by a certified calibration chart.

All gauges shall be at least six inches in diameter. The gauges shall show accurate readings of load increments of one percent of the total capacity of the gauge. The increments shall not exceed two percent of the jacking force used.

The certified calibration charts for the hydraulic jacks and pressure gauges may be checked before and during jacking operations with Department-furnished load cells. If the certified calibration is found to be in error, the operation shall be immediately discontinued until a new certified calibration is performed by the Contractor.

Welding or a welding ground shall not be done near prestressing steel and ducts. Welding near prestressed work shall be done only if specified on the project plans or directed by the Engineer.

B. Post-Tensioning Cast-in-Place Concrete:

Prestressing steel for post-tensioning, which is installed in structures prior to placing and curing of the concrete, shall be continuously protected against rust or other corrosion until grouted by means of an approved corrosion inhibitor placed in the ducts or applied to the steel in the duct. If the tendon is in the duct at the time concrete is placed, no tensioning will be allowed until it is demonstrated to the satisfaction of the Engineer that the prestressing tendon is free and unbonded in the duct.

When prestressing steel for post-tensioning is installed in the ducts after completion of concrete curing, and if stressing and grouting are completed within ten calendar days after the installation of the prestressing steel, rust which may form during the ten days will not be cause for rejection of the steel.

Except as herein provided, cast-in-place concrete shall not be prestressed until at least seven days after the last concrete has been placed in the structure to be prestressed and until the compressive strength of all placed concrete, has reached the required strength for jacking.

The tensioning process shall be so conducted that the force being applied and the elongation of the prestressing steel may be measured at all times. The actual elongation obtained from the calibrated force value shall be compared with the theoretical calculated elongation. A record of the prestressing force and elongations shall be kept at all times and submitted to the Engineer for approval.

Prestressing steel shall be tensioned by jacking from each end of the tendon for continuous structures unless otherwise noted on the project

plans. Such jacking of both ends need not be done simultaneously, unless specifically indicated on the Plans or in the Special Provisions.

Prestressing steel may be tensioned by jacking from one end only for simple span structures.

Should the Contractor elect to furnish an anchoring device of a type which is sufficiently large and which is used in conjunction with a steel grillage embedded in the concrete that effectively distributes the compressive stresses to the concrete, the steel distribution plates or assemblies may be omitted.

Where the end of a post-tensioned assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the prestressing steel and all parts of the anchoring devices will be at least two inches inside of the end surface of the members, unless a greater embedment is shown on the project plans. Following post-tensioning, the recesses shall be filled with concrete for the structure and finished flush.

At no time will a cutting torch be allowed for cutting prestressing steel for cast-in-place prestressed structures.

506.2.3.7 GROUTING OF POST-TENSIONED MEMBERS

Post-tensioned prestressing steel shall be bonded to the concrete by completely filling the entire void space between the duct and the tendon with grout.

All of the tendons in a cast-in-place concrete structure shall have been fully tensioned and anchored prior to any grouting operation.

The grout shall be mixed in mechanical mixing equipment of a type that will produce uniform and thoroughly mixed grout. Water shall be first added to the mixer followed by cement. Retempering of grout will not be permitted. All grout shall pass through a screen with 1/8 inch maximum clear openings prior to being placed in the grouting equipment and shall be continuously agitated until it is pumped.

The quality of the grout shall be determined by the Engineer in accordance with the requirements of Arizona Test Method 311. The efflux time of a grout sample immediately after mixing shall be not less than 11 seconds.

The maximum temperature of the grout shall be 90 degrees F and the minimum 50 degrees F.

Grouting equipment shall be capable of grouting at a pressure of at least 100 pounds per square inch and shall be furnished with a pressure gauge having a full scale reading of not more than 300 pounds per square inch.

Standby flushing equipment capable of developing a pumping pressure of 250 pounds per square inch and of sufficient capacity to flush out any partially grouted ducts shall be provided and available at the job site.

All ducts shall be clean and free of deleterious materials that would impair bonding of the grout or interfere with grouting procedures. Compressed air used to blow out the ducts shall be oil free.

Grout injection pipes shall be fitted with positive mechanical shutoff valves. Ejection pipes shall be fitted with valves capable of withstanding the pumping pressures. Valves shall not be removed or opened until the day following the grouting operation, unless otherwise approved by the Engineer.

Grout shall be pumped through the duct and continuously wasted at the outlet until no visible slugs of water or air are ejected. The outlet pipe shall then be closed and the duct shall then be pressurized. The pressurized duct shall maintain a minimum pressure of 75 pounds per square inch for a minimum time of one minute. The valve at the inlet shall then be closed while maintaining this minimum pressure.

When hot weather conditions would contribute to quick stiffening of the grout, the grout shall be cooled by approved methods as necessary to prevent blockages during pumping operations.

When freezing weather conditions will prevail during and following the placement of grout, the Contractor shall provide adequate means to protect the grout in the ducts from damage by freezing.

The surfaces of concrete against which concrete encasement over anchorage assemblies is to be placed shall be abrasive blast cleaned and aggregate exposed after grouting of the ducts has been completed.

506.2.4 PAYMENT

Payment will be paid at the lump sum price bid for item 506-2, Post-Tensioning For Bridges.

Furnishing and placing reinforcement shown on the project plans for anchorage recesses or blocks, duct ties, and grillage assemblies at anchorages, and any additional reinforcement not shown on the project plans, but required by the post-tensioning system used shall be considered as included in the contract lump sum price paid for prestressing cast-in-place concrete.

Furnishing and placing concrete used in girder web flares and for concrete used in anchorage recesses or blocks, including cover of distribution plates, shall be considered as included in the contract lump sum price paid for prestressing cast-in-place concrete.

Partial payments may be made in accordance with the provisions of Sub-section 109.7.

Payments will be made on the basis of the following:

1. Installation of Ducts 25 Percent of Contract Lump Sum
2. Installation of Tendons 50 Percent of Contract Lump Sum
3. Completion of Tensioning 15 Percent of Contract Lump Sum
4. Completion of Grouting 10 Percent of Contract Lump Sum

515 STRUCTURAL AND MISCELLANEOUS METALS

This Specification shall be used for all nonbridge metal work in lieu of MAG Section 515, Steel Structures.

515.1 GENERAL

This part of the Specifications includes but is not limited to the following items:

- Anchors and anchor bolts
- Bolts
- Miscellaneous metal items shown on the Plans or specified
- Miscellaneous structural steel
- Pipe sleeves and inserts
- Structural Steel

515.2 MATERIALS

Unless otherwise specified or indicated on the Plans or Typical Details, structural and miscellaneous metals shall conform to the standards of the American Society for Testing and Materials (ASTM), latest revision, including but not limited to the following:

<u>Item</u>	<u>ASTM Standard No.</u>	<u>Class, Grade, Type or Alloy No.</u>
<u>Cast Iron</u>		
Cast Iron	A 48	Class 40B
<u>Steel</u>		
Galvanized sheet iron or steel	A 446 A 525 A 526	Coating G90 (min.)
Structural steel	A 36	
Standard bolts, nuts, and washers	A 307	
High strength bolts, nuts, and washers	A 325	

<u>Item</u>	<u>ASTM Standard No.</u>	<u>Class, Grade, Type or Alloy No.</u>
Tubing, cold-formed	A 500	
Tubing, hot-formed	A 501	
Black steel, sheet or strip	A 569	
	A 570	
Coil (plate)	A 635	
Steel pipe	A 53	Grade B

515.3 FABRICATION AND ERECTION

Fabrication and erection of steel items shall conform to AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings wherever applicable, except as the same may be modified by applicable building codes and these Specifications. Where anchors, connections or other details of miscellaneous metalwork are not definitely indicated on the Plans, or specified in the Specifications, their material, size, form, attachment, and location shall be equivalent in quality and workmanship to items specified herein.

Galvanized structural steel or iron shall be hot-dip galvanized after fabrication in accordance with ASTM A 123. Electro-galvanizing shall not be used unless specified. Galvanized items that bend or twist during galvanizing shall be restraightened. Cut or otherwise damaged galvanized surfaces shall be field repaired to equivalent original condition using Galvinox, Galvo-Weld, or equal.

The Contractor shall take all measurements necessary to properly fit his work in the field, and he shall be governed by and be responsible for these measurements and the proper working out of all details. The Contractor shall be responsible for the correct fitting of all metalwork in the field. Sharp or hazardous projections shall be rounded off and ground smooth. The Contractor shall paint steel and miscellaneous ferrous metal items in accordance with these Specifications.

The threads of stainless steel bolts shall be coated, prior to installing the nut, with Never-Seez manufactured by Never Seez Compound Corp., WLR No. 111 manufactured by Oil Research Inc., or equal.

515.3.1 METAL FASTENING

Unless otherwise indicated on the Plans or specified, metal fastening shall be as follows.

515.3.2 BOLTING

A. Bolts, except high strength bolts, shall be provided with flat washers and self-locking nuts, or lock washers and nuts.

1. Bolt heads and nuts shall be hex-type.

2. Bolts, nuts, and washers shall be of domestic manufacture.
- B. Bolts, including anchor bolts, nuts, washers, and similar fasteners specified to be galvanized, shall be galvanized in accordance with ASTM A 153.
- C. After installation, bolts, including anchor bolts and concrete anchors, shall project a minimum of two threads but not more than 1/2 inch beyond the nut.
- D. Unless otherwise specified, bolts, including anchor bolts and concrete anchors, shall be tightened to the snug-tight condition. The snug-tight condition shall be defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

515.3.3 HIGH STRENGTH BOLTS

- A. High strength bolts, nuts, and hardened flat washers shall conform to ASTM A 325 or ASTM A 490, as indicated on the Plans.
- B. Joints with high strength bolts shall be considered to be friction-type structural joints and shall conform to the requirements of AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
 1. A hardened flat washer shall be provided:
 - a. Under the element, nut or bolt head, turned in tightening.
 - b. On short slotted holes of outer plies.
 2. Contractor shall notify Engineer in advance of the method selected for tightening and verification pursuant to the referenced AISC Specification.

515.3.4 WELDING

Welding of structural metals shall be done by welders who have a current American Welding Society (AWS) certificate for the type of welding to be done by the welder. The Contractor shall notify the Engineer at least 24 hours before starting shop or field welding. The Engineer may check the materials, the equipment, and the qualifications of the welders. Welders doing unsatisfactory work shall be removed from the Work, or may be required to requalify.

The Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or any other aid to visual inspection which he may deem necessary on any part or all welds to examine the welds.

The cost of retests on defective welds shall be borne by the Contractor. Cost in connection with qualifying welders shall also be borne by the Contractor.

Welds shall be full penetration welds unless otherwise indicated on the Plans.

515.3.5 WELDING STEEL

Welding of steel shall conform to AWS D 1.1 Structural Welding Code - Steel.

Welding of ASTM A 36 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe shall be with electrodes conforming to AWS A 5.1 Specification for Carbon Steel Covered Arc Welding Electrodes, using E70XX electrodes; AWS A 5.17 Specifications for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding, using F7X-EXXX electrodes; or AWS A 5.20 Specifications for Carbon Steel Electrodes for Flux Cored Arc Welding, using E7XT-X electrodes.

515.3.6 STRUCTURAL METAL

Structural or foundry items shall be carefully fabricated to true dimensions without warp or twist. Welded closures shall be neatly made; and where weld material interferes with fit or is unsightly in appearance, it shall be ground off smooth.

Structural items shall be installed accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting the structure or equipment for which intended. Cocking out of alignment, redrilling, reshaping, or forcing to fit fabricated items will not be permitted. Contractor shall place anchor bolts or other anchoring devices accurately and shall make surfaces which bear against structural items smooth and true to level to preclude the necessity of springing, redrilling, or reshaping.

Structural items needing a special alignment to preserve straight, level, even, smooth lines shall be rigidly supported and braced and kept braced until concrete, grout, or dry pack mortar has hardened for a period of not less than 48 hours.

The Contractor shall submit certified copies of mill tests or reports from a recognized commercial laboratory including chemical, tensile, and bending properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with the applicable ASTM Standards.

515.3.7 STRUCTURAL STEEL

Structural steel shall be delivered free from mill scale, rust, or pitting. Items not galvanized or protected by a shop coat of paint shall be protected from the weather until erection and painting. Contractor shall

provide supplementary parts required for a complete structural steel erection even where such supplementary parts and work are not specified in detail in the Specifications or indicated on the Plans.

515.5 ANCHOR BOLTS AND INSERTS

Anchor bolts shall be cast in place when concrete is placed, wherever feasible. Anchor bolts, concrete anchors, and flush shells embedded in concrete shall be accurately spaced with bolts truly normal to the surfaces from which they project.

All anchor bolts and nuts which will at any time be submerged in water or, in the case of structures customarily containing water, where they are located below the tops of the walls, even if above water level, or in ceilings or overheads, anchor bolts in the dry side of water bearing walls, and anchor bolts securing aluminum to steel or concrete equipment anchor bolts shall be Type 316 stainless steel. Other anchor bolts not required to be of stainless steel shall be stainless steel or galvanized carbon steel conforming to ASTM A 307 or ASTM A 36, at the Contractor's option.

Concrete anchors and flush shells shall be as specified in the following paragraphs.

Anchor bolts shall not touch reinforcing steel. Where anchor bolts are within 1/4-inch of reinforcing steel, anchor bolts shall be insulated with not less than three wraps of 10-mil PVC tape in the area adjacent to the reinforcing steel.

In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut. All bolts, when indicated for future use, shall be first coated thoroughly with nonoxidizing wax, followed by turning nuts down to the full depth of thread. Exposed thread shall then be neatly wrapped with a waterproof polyvinyl tape.

515.5.1 INSTALLATION

Unless indicated otherwise on the Plans, anchor bolts shall be embedded not less than 12 diameters and shall have a head or a hook not less than 4 diameters in length. Where indicated on the Plans, anchor bolts shall be set in metal sleeves having an inside diameter approximately 2 inches greater than the bolt diameter and not less than 12 bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted in place.

515.5.2 CONCRETE ANCHORS

Concrete anchors, where indicated on the Plans or specified, shall mean drilled in place anchors with integral anchor bolts. Concrete anchors shall be ITT-Phillips Red Head "Wedge Anchors" with integral anchor bolts; Expansion Products Company "Wej-It" concrete anchors with integral anchor bolts; or equal.

The material of each concrete anchor, including its integral anchor bolt, washer, and nut, shall be stainless steel Type 304 or Type 316.

Concrete anchors shall have the following minimum embedment lengths:

<u>Size, Inches</u>	<u>Embedment Length, Inches</u>
1/4	1-3/4
3/8	1-7/8
1/2	2-1/4
5/8	2-3/4
3/4	3-1/4

Prior to installation or use of anchor bolts, the Contractor shall perform the following test with the test results subject to review and acceptance by the Engineer. The Contractor shall furnish not less than four Type 304 or Type 316 stainless steel anchor bolts, 5/8-inch size of the type proposed to be used, and install the anchor bolts in a test block of concrete to the specified embedment length. After the concrete has set, the Contractor shall furnish and install one 5/8-inch nut on each anchor bolt. Each nut shall be tightened with an applied torque of 10 foot-pounds. Each nut shall then be loosened, and then retightened with an applied torque load of 10 foot-pounds. Any visible evidence of turning of any of the anchor bolts shall be cause for rejection of the concrete anchors by the Engineer.

Anchor bolts may be cast in the concrete in lieu of using concrete anchors.

Cast iron, lead cinch, or slug-in anchors will not be accepted as substitutes for concrete anchors.

515.8 PAYMENT

Unless otherwise provided in the proposal, the basis of payment for steel and miscellaneous metal shall be as follows:

Payment for all miscellaneous metal will be made at the lump sum price bid for Item 515-1, Miscellaneous Metal.

Full compensation for furnishing and placing sheet piling, preformed fabric pads, elastomeric or elastic bearing pads, and red lead paste, and for grouting masonry or bearing plates as indicated on the Plans shall be considered as included in the price paid for structural and miscellaneous metal and no separate payment will be made therefore. Where the Specifications or Plans require metal to be galvanized, the price paid, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing the galvanized metal complete in place, as indicated on the Plans, and as specified in the Specifications and the Special Provisions, and as directed by the Engineer.

520 STEEL HANDRAILS

Item 520 - Steel Handrails shall conform in their entirety to the requirements of Section 520 of the Uniform Standard Specifications.

600 WATER AND SEWER

Pipeline construction shall be in accordance with MAG Section 600 and DIVISION 15 of the Special Provisions. In the case of conflict, DIVISION 15 shall apply.

Payment shall be made at the unit prices bid for Items 1500-1 through 1500-22.

601 TRENCH EXCAVATION, BACKFILLING, AND COMPACTING

Item 601 - Trench excavation, backfilling, and compacting shall conform in their entirety to the requirements of Section 601 of the Uniform Standard Specifications. Pipe bedding shall be as shown on the Plans.

Mechanical compaction methods only shall be used, unless approved, in writing, by the Engineer.

601.2.8 DEWATERING TRENCHES

This item covers the entire project except as specified elsewhere in these Special Provisions.

Any water encountered during installation of the new pipes shall be disposed of by the Contractor in such a manner as will not cause damage to public or private property or constitute a nuisance or menace to the public. The Contractor shall furnish, install, and operate pumps, pipes, appliances, and equipment of sufficient capacity and so located as to keep all excavations and accesses free from water while work is in progress, and during weekends and holidays when required by the Engineer. The Contractor shall provide all means or facilities necessary to conduct water to the pumps. This is not a pay item.

611 DISINFECTING WATER MAINS

Disinfecting water mains shall be in accordance with MAG Section 611.

DIVISION 9

FINISHES

090000 GENERAL

The Contractor shall furnish all labor, materials, and equipment necessary to do all the work specified or required by these Contract Documents. All materials specified by name, brand, or manufacturer, or selected for use shall be delivered unopened at the jobsite in their original containers bearing the manufacturer's label. No material other than that specified or accepted shall be delivered, stored, or kept at the jobsite.

090100. PAINTING - GENERAL

No lead paints shall be used.

Coatings used in conjunction with potable water supply systems shall have U.S. Environmental Protection Agency (EPA) and FDA approval for use with potable water and shall not impart a taste or odor to the water.

Complete data on each type and kind of paint and primer shall be submitted to the Engineer for review and acceptance. Acceptance shall be received from the Engineer before the paint is delivered to the jobsite. This procedure must be followed whether or not the paint that the Contractor proposes to use is named in the Contract Documents. Submittal data shall show where and for what uses each paint product is proposed to be used with cross reference made to paragraphs of the Contract Documents or Painting Schedule. Data submitted on each proposed type and kind of paint shall include data to show that the paint meets the detailed requirements herein.

Paints not listed in the Contract Documents and which are submitted for review shall be submitted with a certified ingredients analysis. Data shall include sufficient information for making a complete comparison between specified and proposed paint.

Colors shall be as specified or as selected by the Engineer. Colors will not necessarily be standard colors with all suppliers, and colors shall be mixed by the manufacturer to secure desired color when not standard. The Contractor shall prepare and submit color chip samples for all items which require color selection by the Engineer. If requested for special architectural finishes, the Contractor shall also submit 6-inch x 6-inch samples similar to the intended coated surfaces and coated with the selected color. No color selection will be made until all samples of all paints have been submitted. After all samples of all paints have been submitted, the Engineer will prepare a color scheme using the submitted colors.

All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and

coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the the local, State, and Federal requirements.

At the end of the project, the Contractor shall turn over to the Engineer a gallon can of each type and color of paint, primer, thinner, or other coating used in the field painting. If the manufacturer packages the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with typed labels indicating brand, type, color, etc. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A typewritten inventory list shall be furnished at the time of delivery.

090101 MANUFACTURERS' INSTRUCTIONS

The manufacturers' published instructions for use as a guide in specifying and applying the manufacturers' proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before acceptance of the manufacturers' instructions is given by the Engineer.

A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meet the following requirements:

The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.

All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended, that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following list:

- Methods of application
- Number of coats
- Thickness of each coat
- Total thickness
- Drying time of each coat, including primer
- Primer required to be used
- Primers not permitted
- Use of a primer
- Thinner and use of thinner
- Temperature and relative humidity limitations during application and after application
- Time allowed between coats

Protection from sun
Physical properties of paint including solids content
and ingredient analysis
Surface preparation
Touch up requirements and limitations

Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating.

090102 SPECIFIED PRODUCTS LIST

Certain manufacturers are listed hereinafter along with certain of their products for specific uses as scheduled. These manufacturers, and their products, are acceptable for use on this project. Any other manufacturer, or their product, not specifically referred to herein will not be considered for use; unless the manufacturer can show specific case histories of their products successful use on similar installations and service duties without the failure of their coating products, along with references from and to owners, engineers, and applicators who have used their products.

<u>Brand Name</u>	<u>Manufacturer</u>
Amchem	Amchem Products Fremont, California
Amercoat	Ameron Corporation Brea, California
Borden	Borden Chemical Company 50 West Broad Street Columbus, Ohio 43215
Carboline	Carboline Company St. Louis, Missouri 63144
Glidden	Glidden-Durkee Division of SCM Corporation Cleveland, Ohio 44115
Inertol and Ramuc	Koppers Company, Inc. Koppers Building Pittsburgh, Pennsylvania 15219
Koppers	Koppers Company, Inc. Koppers Building Pittsburgh, Pennsylvania 15219

Mobil	Mobil Chemical Company Maintenance and Marine Coatings Dept. Azusa, California 91702
NO-OX-ID	Sanchem, Inc. 1600 S. Canal Street Chicago, Illinois 60616
Porter	Porter Coatings Division of Porter Paint Company Louisville, Kentucky 40201
Sherwin-Williams	The Sherwin-Williams Company 101 Prospect Avenue, N.W. Cleveland, Ohio 44115
Tnemec	Tnemec Company, Inc. 123 West 23rd Avenue North Kansas City, Missouri 64116

090103. PREPARATION OF SURFACES

Paint surface preparation shall be as specified in the following or as recommended by the paint manufacturer's published application instructions, whichever imposes the most stringent requirements.

All surfaces to be painted shall be clean and dry except that in some cases the paint manufacturer's directions may require wetting the surface before painting.

Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the Steel Structures Painting Council (SSPC). Where Steel Structures Painting Specifications are referred to in these Contract Documents, the corresponding Pictorial Surface Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed by wiping with mineral spirits or naphtha per Specification SP-1. Rust, scale, welding slag, and spatter shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in accordance with the appropriate Specification SP-2 through SP-10.

Unless otherwise specified, all iron or steel surfaces which are to be painted as submerged or high temperature metal shall be sandblasted on the site in accordance with Specification SP-10, near white blast cleaning or better. Sandblasting shall provide a roughened surface profile of not less than 2.0 mils in depth. Sandblasting shall be with abrasive Ottawa flint silica 30 to 50 mesh, Clemtex No. 2 silica 20 to 40 mesh, silica sand 20 to 40 mesh. All metal surfaces which are to be painted as submerged metal shall be commercial blast cleaned per Specification SP-6 except as otherwise specified, or in locations where sandblasting would damage previously coated surfaces and installed equipment, and in locations where dry sandblasting is prohibited. The above locations in which

SP-6 commercial sandblasting is not possible shall be given an SP-3 power tool cleaning. This sandblasting shall be done not more than 12 hours ahead of the painting, subject to humidity and weather conditions between the time of sandblasting and painting operations. If any rusting or discoloration of sandblasted surfaces occurs before painting, such rusting or discoloration shall be removed by additional sandblasting. Sandblasted surfaces shall not be left overnight before painting. No surface which is to be sandblasted shall be given a coat of primer or paint in the shop or in the field before sandblasting.

Surfaces to be painted at erection welds, surfaces exposed by damage to the coating, as during erections, shall be cleaned as above before painting.

Threaded portions of valve and gate stems, machined surfaces which are intended for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated or galvanized items shall not be sandblasted unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to be sandblasted shall be sandblasted in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

There will be some surfaces which cannot be sandblasted, or which cannot be sandblasted and painted, after the items of which they are a part have been assembled in final position. These surfaces shall be sandblasted, or sandblasted and painted, before the items are put into final position. In some cases while the painting could be done after the items concerned were in place, the limitation on time between sandblasting and painting may make it necessary to paint the surfaces before installation of the items concerned.

Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the Engineer.

Concrete and masonry surfaces shall be free of dust, mortar droppings and spatter, fins, loose concrete particles, form release materials, oil, grease, and other deleterious materials. If required by the coating manufacturer, such surfaces shall be etched as specified above or brush-off blast cleaned.

Wood surfaces to be painted shall be cleaned of dirt, oil, or other foreign substances with mineral spirits, scrapers, sandpaper or wire brushes. Sandpaper any roughness after first prime coat. Wood shall be cleaned and dusted before painting. Shelves, drawers, benches, and associated woodwork shall be sanded before painting and lightly sanded between

coats. All knots and sappy places shall be coated with liquid shellac of not over two pound cut after the priming coat has been applied and dried. Nail holes, cracks, open joints and other defects in all interior woodwork shall be filled with putty colored to match the finish coats after the priming coat has been applied and is dry.

All painted surfaces shall be dusted between coats and high gloss finishes shall be lightly sanded and dusted between coats unless otherwise directed by the manufacturer.

Surfaces which are to be painted with other than bituminous paint and which have had a bituminous coating (such as coal-tar varnished pipe), shall be sealed with not less than 2 coats of Inertol Tar Stop, Sherwin-Williams Metalatex B-42 W100, Glidden Insulcap, or equal, in sufficient quantity to permanently prevent bleeding of the bituminous coating.

Galvanized surfaces which are to be painted shall be treated as per paint manufacturer's recommendations.

All fiberglass to be painted shall be lightly sandblasted or sanded to roughen surfaces just prior to painting.

Plastic surfaces shall be solvent-washed to dull the surface, using a vinyl thinner approved by the finish coating manufacturer.

Aluminum, copper, and other metal surfaces shall be lightly sanded or receive surface preparation as specified in the following or as recommended by the paint manufacturer.

090104 APPLICATION OF PAINT

The applicator of the paint shall have had past experience in applying the type or types of coatings and under similar conditions that he will be required to meet in this Contract. The Contractor shall verify the paint applicator's qualifications and past performance before subcontracting the work to him.

No painting shall be done under dusty conditions, during or immediately after a rain, during rainy weather, when the ambient and/or surface temperature is less than 50 degrees, or when the temperature exceeds that recommended for application by the paint manufacturer. Relative humidity shall be between 30 and 85 percent and the dew point shall not be within 5 degrees of the surface temperature.

Paint may be applied by brush, roller, trowel, or spray, unless the manufacturer's recommendations or these Contract Documents call for some particular type of application. Where spray application is used, each coat of paint shall be applied to a thickness equivalent to a brush coat application at a coverage not greater than that specified by the manufacturer for a brush coat application. All spray painting shall be by the airless method except where specifically allowed by the Engineer for architectural

painting. All air spray units shall have operable line filters for removal of all oil and moisture. The Contractor shall demonstrate the efficiency of the line filters before applying any paint.

Spray painting shall be conducted under controlled conditions and the Contractor shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.

All work shall be done leaving the finished surfaces free from drops, ridges, waves, holidays, laps, or brush marks. Drop cloths and other coverings shall be so placed at all times as to protect floors, other surfaces, and equipment from spatter and droppings. Hardware, plates, lighting fixtures, nameplates, and similar articles which are not to be painted shall be masked off or removed completely. After completion of painting, any spatter or droppings shall be removed.

Primer and intermediate coats of paint shall be unscarred and completely integral at the time of application of each succeeding coat. Each coat shall be subject to inspection and acceptance by the Engineer before the next succeeding coat is applied, and defective work of any kind shall be deemed sufficient cause for stripping, removal, and repreparing if required by the Engineer followed by recoating the entire surface involved.

Except as otherwise provided in these Contract Documents, prime coats, undercoats, and finish coats on any one item shall be of the same manufacturer. If the incorrect prime coat is applied for any reason, it shall be sandblasted off and replaced with the specified primer.

When multiple coats of the same material are specified, the prime coat and undercoats applied shall be tinted with aluminum powder, lamp black, or other suitable pigment to distinguish it from the following coat and finish coat.

Sufficient time shall be allowed between coats to insure proper drying unless the manufacturer's recommendations specifically state otherwise. Excessive time or exposure between coats shall not occur in cases where such excessive time or exposure will impair the bond between coats. To prevent impairment of bond between coats, space heaters shall be provided to dry the coat or keep the coating dry, if recommended by the paint manufacturer.

The number of coats specified is the minimum to be applied. Suction spots between coats shall be touched up, and additional coats shall be provided if required to produce a finished surface of solid, even color, free from defects. The total thickness of the coating shall be as specified. Additional coats of paint shall be added if necessary to bring the total thickness up to not less than that specified. No holidays shall be left. Particular care shall be used to assure that the specified coverage is secured on the edges and corners of all surfaces. Additional brush coats shall be applied if necessary to cover the edges and corners. The Contractor shall control and check the dry film thickness of all coatings.

The Contractor shall control and check the dry film thickness on metal surfaces with a correctly calibrated thickness meter and shall check for holidays with a low-voltage holiday detector. The Engineer may use the Contractor's detector for additional checking. However, the Engineer will use an Elcometer to check the dry film thickness of the coatings, and his findings utilizing this meter will be final as to the dry film thickness of the applied coatings.

Damaged paint or scratched painted surfaces shall be sanded smooth before repainting. Sanding and repainting shall be done to such a degree and in such a manner that all evidence of the scratches or damages are obscured.

090120. ITEMS NOT PAINTED

The following items shall not be painted, unless specifically called for:

- Aluminum, brass, bronze, copper, plastic, rubber, stainless steel, chrome, everdur, or lead
- Buried or encased piping or conduit
- Exterior concrete
- Galvanized pipe trays and cable trays (supports or hangers for these shall be painted)
- Galvanized steel framing
- Grease fittings
- Nameplates
- Plastic or fiberglass piping
- Serial numbers
- Steel encased in concrete or masonry
- Warning or operating instruction labels

090140 PAINTING METAL SURFACES

Except as otherwise specified or indicated in the Painting Schedule, all metal shall be painted. Metal surfaces shall be primed and painted as specified in the following paragraphs.

Steel and miscellaneous iron items which are to be built into masonry or concrete shall, unless otherwise noted, have no field painting. Steel and miscellaneous iron items which have had a shop primer and which will be concealed above the ceilings shall be field primed. This includes but is not limited to the unexposed underside of steel roof decks and structural steel items such as beams, channels, and angles. Touching up of these items shall be done after erection but before installation of the ceiling system. No further painting of these items will be required.

090141 PRIMING OF METALS

Metals shall be primed as specified in the following.

090141.01 SHOP PRIMING OF METALS

Certain items have been listed to receive complete finish at the factory. Surfaces specified to be field sandblasted and galvanized surfaces shall not be shop coated. All other ferrous surfaces, except stainless steel and surfaces specified or shown to receive epoxy or grease type coatings, shall receive a shop coat of primer compatible with the finish coats specified. Primers shall be as specified for field priming. Surface preparation shall be as specified hereinbefore. Shop primer shall be compatible with field primer and finish coats. Shop primer shall be applied to a dry film thickness of not less than 2.0 mils.

090141.02 FIELD PRIMING OF METALS

All shop primed metal surfaces shall be field primed as follows before the finish coats are applied. All abraded, scratched, or otherwise damaged areas in the shop prime coat shall be sanded smooth or receive power tool cleaning SP-3 and then spot primed. The entire surface shall then be given a second prime coat compatible with the shop prime coat and the finish coats. Where the entire shop priming is failing, weathered excessively, or where recommended by the paint manufacturer's representative, the entire shop prime coat shall be removed with SP-6 commercial sandblast surface preparation before repriming.

Paint manufacturer's representative shall recommend changes in metal primers where specified primers and finish coats are not compatible. Changes shall be submitted for review and acceptance. Where the shop primer is not compatible with field primer and/or finish coats, the shop primer shall be removed by sandblasting to not less than SP-6 commercial sandblast. All shop primer shall be removed from all metal to be installed as submerged metal by sandblasting to near white SP-10.

Primer shall be applied to a dry film thickness of not less than 2.0 mils. Primer shall be finish coated within the time recommended in writing by the paint manufacturer. Primed surfaces exposed longer than this recommended period shall be SP-7 sandblasted and reprimed prior to finish painting.

Galvanized, sherardized, aluminum, copper, or bronze surfaces to be painted shall be solvent cleaned and receive a surface preparation as specified hereinbefore, then either wash coated and primed or primed with a special primer in accordance with the directions of the manufacturer of the finish coats.

090144. UNSUBMERGED METALS

Interior and exterior unsubmerged metals that are not specified to be painted otherwise shall be painted with a polyester aliphatic polyurethane.

These items shall include but not be limited to the items listed in Section 090199 Painting Schedule.

The Contractor shall coordinate selection of color for all unsubmerged metals (exclusive of piping) with the Engineer and City of Phoenix prior to application. Piping shall be color coded in accordance with Specification Section 090146 PIPE COATINGS.

The painting system shall be as follows, or equal, applied to dry film thickness of not less than 7.5 mils for metals which can be sandblasted and 4.0 mils for metals which cannot be sandblasted.

Metals which can be sandblasted:

TNEMEC: Field primer of Series 104 High Solids epoxy at a dry film thickness of not less than 6.0 mils followed by a field finish coat of Series 71 (color to match plant's existing color coding) Endura-Shield at a dry film thickness of not less than 1.5 mils.

Metals which cannot be sandblasted:

TNEMEC: Field primer Series 27 Typoxy at a dry film thickness of not less than 2.5 mils, followed by a field finish coat of Series 71 (color to match plant's existing color coding) Endura-Shield at a dry film thickness of not less than 1.5 mils.

090145. UNDERGROUND METALS

All underground metals shall be coated. Pipe coatings are covered under the individual pipe sections in DIVISION 15.

Underground valves and valve boxes shall be coated with not less than 2 coats of asphalt varnish in accordance with AWWA C-500.

Underground pipe flanges (excluding pipe), corrugated metal pipe couplings, flexible pipe couplings and miscellaneous underground metals not specified otherwise to receive a protective coating, shall be coated with not less than 20 mils of T.C. Mastic as manufactured by the Tapecoat Company, Bitumastic No. 50 as manufactured by the Koppers Company, Inc., or equal.

090146 PIPE COATINGS

Pipe (insulated and uninsulated), miscellaneous pipe fittings, and valves shall be coated and color coded as specified in the following. Insulation, if called for, shall be sealed as specified herein.

090146.01. PIPE COLOR CODING AND IDENTIFICATION

Exposed pipe, including valves and appurtenances, shall be color coded as listed in the following table except submerged pipe, pipe supported in cable or pipe trays (small diameter), and pipe less than 3/8 inch in diameter and where specified otherwise. Pipe nominal 3/8 inch or smaller shall be painted the same as the wall, ceiling, or piece of equipment to which it is attached.

All pipe to be color coded shall be painted the background color indicated in its entirety. When so indicated, it shall be further identified by an 8-inch wide circumferential band at its origin and termination, on each side of all walls, above and below all floors and ceilings, at points of entering or leaving pipe or cable trays, at all valves and fittings, and at no greater than 25-foot intervals between such markings.

Where two or more pipes run parallel, markings shall be applied in the same relative location on each so as to be in vertical or horizontal linearity as the case may be and present a neat appearance. Where numerous fittings occur close together, as in manifolds and around equipment, the above specifications as to location of banding shall be modified as indicated by good judgment to prevent a cluttered appearance.

Loose handles, wrenches, operating keys, etc. for valves shall be painted along with the valves.

PIPE COLOR CODE CHART

<u>Pipe Contents</u>	<u>Background Color</u>	<u>Bands</u>
All Pipelines	Tan (or alternate earth tone color selected by the treatment facility supervisor)	None

ANSI colors shall be in accordance with ANSI Z 53.1 (latest edition).

After painting, all pipelines, including tubing, aboveground inside or outside of structures and buildings, in concrete trenches or tunnels, in boxes, etc., and in pipe trays shall be marked with an identification marker indicating the contents of the pipe in accordance to color coding schedule and direction of flow arrow. Identification markers shall be placed at not greater than 25-foot intervals inside buildings and at not greater than 50-foot intervals exterior to buildings, in tunnels, and other locations. Letter and number size for identification markers shall be as indicated in the table.

<u>OD of Pipe or Covering (inches)</u>	<u>Length (min.) of Color Band (inches)</u>	<u>Height of Letters (inches)</u>
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

Unless the line is in such a location that it can be seen only from one direction, such as pipes near a wall, two sets of the code designation shall be applied at each location, placed in the two visible quadrants, with respect to normal viewing positions. In general, pipe identification size, color, and arrangement shall be in accordance with ANSI A 13.1 (latest edition).

All identification markers shall be as manufactured by W. H. Brady Company; Elcen Metal Products Company; or equal. Markers shall be coated with a clear plastic coating following application. Coating shall be as recommended by marker manufacturer.

090146.02. COATING METAL PIPE

Color coded metal pipe shall be coated with a polyester aliphatic polyurethane system as indicated in the Paint Schedule and specified in Section 090144. Colors for color coding of pipe shall be as specified above.

090149. DISSIMILAR METALS

Where aluminum surfaces come in contact with dissimilar metals, except Type 304 or 316 stainless steel, aluminum surfaces shall be kept from direct contact with said metal by use of neoprene gaskets or washers, polyethylene self-adhesive tape (two wraps of 20-mil tape). Galvanizing or paint will not be considered as adequate protection.

Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction shall be given a heavy coat of an alkali-resistant bituminous paint or two coats of a zinc chromate primer before installation. The bituminous paint shall be Koppers Bitumastic Black Solution, Porter Tarmastic No. 104, Tnemec 449 Heavy Duty, Black or equal. The paint shall be applied as it is received from the manufacturer without the addition of any thinner, and the surface shall be cleaned according to the manufacturer's instructions. Not less than two coats shall be applied. Zinc chromate shall be allowed to air dry 24 hours before the aluminum is placed in contact with the concrete. Paint shall be Sherwin-Williams zinc chromate primer B50 Y1, Glidden No. 5533 zinc chromate primer, or equal. All exposed surfaces shall be cleaned of any coating before installation.

Coatings shall be continuous and holiday free.

All stainless steel bolt and screw surfaces in contact with aluminum shall be coated with Never-Seez by Never Seez Compound Corp., WLR No. 111 by Oil Research Inc., or equal.

090170 PAINTING FIBERGLASS AND PLASTIC

Exposed fiberglass and plastic indicated in the Painting Schedule or specified shall be coated with two coats of vinyl paint following surface preparation to a dry film thickness of not less than 4 mils. PVC and other plastics shall have the surface roughened by solvent washing with xylene or vinyl thinner approved by the paint manufacturer. Fiberglass shall be cleaned per SSPC-SP-1 (solvent cleaning) and coated immediately after drying. Painting systems shall be the following or equal systems.

AMERON: Apply two coats of Amercoat No. 99.

GLIDDEN: Apply one coat of Glidden 5521 Vinyl-Cote Primer followed by one coat Glidden 5514 Double Build Vinyl.

KOPPERS: Apply one coat of Rigortex 3305 Intermediate Coat followed by one coat of Rigortex 3305 Finish Coat.

TNEMEC: Apply one coat of Vinoline 53 Hi-Build Mastic followed by one coat of Vinoline 35.

MOBIL: Apply two coats of Mobil 80 Series.

090184 SPECIAL COLOR AND PAINTING REQUIREMENTS

Items specified in the following shall be finish color coated as specified. ANSI colors shall conform with (OSHA) ANSI Z53.1-1971 and latest revisions. Color coating shall be with the system specified for the equipment.

090184.01 RED

Items listed in ANSI Z53.1-1971, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; danger signs and locations; and stop bars, buttons, or switches. In addition all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.

090184.02 ORANGE

Items listed in ANSI Z53.1-1971, Section 2.2 shall be painted ANSI Orange. ANSI Orange shall be used as a basic color for designating dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure and to emphasize such hazards when enclosure doors are open or when gear belt or other guards around moving equipment are open or removed, exposing unguarded hazards. In addition, moving machinery having a linear or peripheral speed in excess of 10 feet per minute, which is either inadequately guarded due to physical problems or may be operated with the guard removed, rims of sprockets, gears, pulleys, etc.; cross-heads of large engines and compressors; and flywheels shall be coated ANSI Orange.

090184.03 YELLOW

Items listed in ANSI Z53.1-1971, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.

090184.04 GREEN

Items listed in ANSI Z53.1-1971, Section 2.4 shall be painted ANSI Green. Green shall be the basic color for designating safety and the location of first-aid equipment. In general, gas masks, first-aid kits, eye wash facilities, and safety deluge showers shall be coated ANSI Green.

CONSTRUCTION SPECIAL PROVISIONS

CONTRACT NO. FCD 88-40

Page 53 of 103

090199. PAINTING SCHEDULE

Painting shall be as specified in this section of the Contract Documents and as indicated on the Plans and specified herein.

In general, all steel, iron, and wood surfaces shall be painted unless specifically indicated or specified otherwise. Concrete surfaces shall be painted only where indicated or specified. In general, exterior concrete and concrete exposed to wastewater inside basins and tanks shall not be painted and concrete and masonry inside buildings, basements, equipment rooms, etc. shall be painted. Aluminum surfaces shall not be painted unless specifically indicated or specified.

The Painting Schedule sets forth a listing of the type of items and type of paint system which they shall receive. This Schedule shall compliment the lists of items to be painted listed hereinbefore. This listing is not necessarily complete, and items of a like nature as shown in the Painting Schedule shall be painted the same as if they were included in the Painting Schedule. In case of question as to whether an item is to be painted, or as to type of paint system to use, the Engineer shall be consulted to render a judgment.

SCHEDULE OF METAL SURFACES TO RECEIVE PAINT

- a. Polyester Aliphatic Polyurethane (090144. and 090146.)
 - 1. Piping, pipe hangers, supports, and saddles; conduits, cable tray hangers and supports;
 - 2. Other miscellaneous metals listed or not listed in the Painting Schedule.
- b. Coal-Tar Mastic (090145)
 - 1. Underground flexible couplings.
 - 2. CMP couplings.

SCHEDULE OF FIBERGLASS AND PLASTIC SURFACES TO RECEIVE PAINT

- a. (090170)
 - 1. All plastic piping except buried piping, or piping below the water surface.

DIVISION 15

PIPING, VALVES, GATES, AND SPECIALTIES

150000. GENERAL

Piping shall be installed as indicated on the Plans. The Contractor shall submit to the Engineer, for review and acceptance, his detailed proposed piping layouts.

Any pipe which does not meet specifications or has been rejected, shall be removed from the jobsite and disposed of by the Contractor at no extra cost to the Owner.

Where new fittings are to be cut into or attached to existing piping or where connections are to be made to existing piping, the Contractor shall furnish and install the necessary sleeves, flanges, nipples, couplings, fittings, or other devices needed to accomplish the cutting-in or connections, whether indicated on the Plans or not.

Lines under low head shall be laid flat or with a continuous grade so that there will be no air traps or humps in them, except at the ends where means for venting shall be provided.

In no case shall copper or copper alloy pipe or fittings carrying water or water based solutions or slurries be attached to cast-iron or steel pipe except by means of a dielectric coupling expressly made for this purpose and service.

All pipe which will operate under pressure shall be properly blocked at all fittings where the pipeline changes direction, changes size, or ends, using concrete thrust blocks in trenches and suitable anchors in structures. Concrete thrust blocks shall be sized so as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing an earth bearing of 200 pounds per square foot per foot of depth below natural grade. (Earth bearing value may be increased, if substantiated by soils analysis.) The line pressure shall be the product of the nominal cross sectional area of the pipe and the test pressures as specified for each type of pipe. The concrete shall be placed, unless indicated otherwise on the Plans, so that the pipe joints and fittings will be accessible.

150010 EXPOSED PIPING

Where not detailed, exposed pipe shall be installed in straight runs parallel to the axes of the structures. Pipe runs shall be horizontal and vertical except that gravity drain lines shall be sloped down in the direction of flow not less than 1/8 inch per foot.

No exposed piping shall be erected until all equipment to which the pipe is to be attached has been installed and it can be determined where piping and fittings shall be located to make a neat efficient arrangement.

The Plans shall be taken as diagrammatic for piping that is not shown in detail. Sizes of piping and their locations are indicated, but it is not intended to show every offset and fitting nor every structural difficulty that will be encountered during the installation of the work.

The alignment of pipes shall be varied from that indicated on the Plans, without extra expense to the Owner where necessary to avoid structural or mechanical difficulties or to avoid the work of other trades. The Contractor shall furnish such parts and pieces as may be necessary to provide a complete and operable system.

Pipework shall be suspended and supported in such manner as to prevent sagging or overstressing of pipe and connections and, also, so that no item of the piping system shall transfer any load or stress to any equipment.

Piping shall be made up with a sufficient number of unions or flanged joints to permit ready breaking of lines as necessary for inspection and maintenance, in addition to such joints as are definitely indicated on the Plans.

Pipe and fittings shall be assembled so there will be no distortion or springing of the pipelines. Flanges, unions, flexible couplings, and other connections shall come together at the proper orientation. The fit shall not be made by springing any piping nor shall orientation alignment be corrected by taking up on any flange bolts. Flange bolts, union halves, flexible connectors, and similar devices shall slip freely into place. If the proper fit is not obtained, the piping shall be altered to fit.

150011. WALL AND SLAB PENETRATIONS

Unless indicated otherwise on the Plans, no pipe shall pass through or be built into any reinforced masonry or concrete wall, floor, ceiling, roof, pilaster, column, pier, or beam, unless it is inside of a sleeve; and such sleeves shall have an inside diameter not less than the outside diameter of the pipe plus 2 inches, except that for pipe smaller than 2 inches the ID of the sleeve shall be not less than twice the OD of the pipe. Such sleeves shall be placed not closer than three diameters center to center, nor shall they impair the strength of construction. The arrangement of sleeves shall be such that pipe can be pulled out of a sleeve and replaced without disturbing the structural member. Ends of sleeves shall be flush with surfaces of concrete, masonry, or plaster.

150020. BURIED PIPING

All pipelines laid in open trenches shall conform to MAG Uniform Standard Specifications, Section 601.

Gravity pipelines shall be laid to the lines and grades indicated on the Plans, and shall be laid upgrade. Where not otherwise indicated on the Plans, all buried lines shall be laid with a minimum of 3-foot cover without air traps or humps. Where two lines of similar service run parallel to each other, they may be laid in the same trench as close together as possible and still provide adequate room for jointing and compaction of bedding material.

Before excavation is started for any run of underground piping, the Contractor shall locate and expose all existing structures, piping, conduit, etc., which intersect the line of the piping, to avoid possible damage to these during excavation operations and so that it may be determined if there will be any conflicts in location. In the event of conflicts in location or grade or both, between new piping and existing piping, the Contractor shall make adjustments in location or grade of new piping acceptable to the Engineer.

Unless otherwise indicated on the Plans or specified, where pipe of any type is to be encased in concrete, the encasement shall provide a minimum of 6 inches of concrete completely around the pipe, shall fill the bottom of the trench from bank to bank, if not formed, and shall be reinforced with four continuous longitudinal reinforcing bars, one in each corner of the encasement. Concrete shall be Class C. The length of encasement indicated on the Plans, or specified, shall be the minimum length, and the encasement shall terminate at each end at a joint in the pipe. Reinforcing bars shall be No. 4 for encasement of pipe 36 inches and smaller and No. 6 for encasement of pipe larger than 36 inches.

Where buried ductile iron, reinforced concrete, asbestos cement, vitrified clay, or similar rigid pipe enters a structure, it shall be by means of a coupling or wall piece cast into the wall, having a mechanical push-on, or similar flexible joint as specified or indicated on the Plans at the outside face of the wall. An additional similar joint shall be installed in the line at the edge of the structure excavation where the pipe trench leaves undisturbed ground. For steel pipe a single joint may be used located not more than 2 feet from the outside face of the wall.

At the close of the day's work, and at such other times when the pipe is not being laid, all openings in the end of the pipeline shall be closed with an accepted plug.

150021 LAYING OF PIPE AND FITTINGS

In laying pressure pipelines, the deflection in a standard joint shall not exceed the manufacturer's recommendation. Horizontal and vertical deflections of not more than the recommended combined angle, including curves as indicated on the Plans, shall be made by deflections in standard pipe joints within 10 feet of the indicated stations. Five degree beveled joints may be used. Deflections of more than 5 degrees shall require special bends or fittings. Departure from and return to established

alignment and grade shall not exceed 1/16 inch per linear foot of pipe and at no point shall the maximum departure from established line and grade be greater than 1 inch.

The laying of all pipe shall be in finished trenches free from water or debris. The joining of pipe sections shall be such as to produce water-tight lines. Pipe shall be laid on an unyielding foundation with uniform bearing under the full length of the barrel. If the pipe bears top or bottom markings, it shall be placed with the markings in the proper position. All adjustments to line and grade shall be made by scraping away or filling in under the pipe. Pipe shall not be dropped or pounded to fit grade. If the joints are the type which require external grouting, banding, or pointing, space shall be provided under and immediately in front of the bell end of each section laid of such shape and size as to permit sufficient room for the grouting, banding, or pointing of the joints.

Each section of pipe shall be lowered into the trench, utilizing a sling or other device, in a manner that shall prevent injury to the pipe, coating, lining, or joints. Under ordinary conditions of laying, the work shall be so scheduled that the bell end of the pipe faces in the direction of laying. In placing pipe in the trench, the pipe shall be held by the lowering device at the balancing point of the section. It shall not be dragged on the bottom of the trench but shall be supported while being fitted into the adjacent section. Supporting the pipe on blocks, or blocking of any nature, either temporary or otherwise, will not be allowed.

It is the responsibility of the Contractor, when the pipeline and appurtenances are finally laid, to see that all joints are protected and that any damage to the coating or lining of the pipe and fittings has been adequately repaired or replaced in order to preserve their integrity for corrosion protection.

150022 JOINTING OF RUBBER GASKETED PIPE

Unless specified otherwise under a particular type of pipe, the jointing of pipe with rubber gaskets shall be in accordance with the manufacturer's published instructions and this section.

The ends of the pipe shall be thoroughly cleaned with wire brushes or the equivalent to remove all foreign materials, including sealing compound, if any, from surfaces which are to be incorporated in the joint. The spigot recess, the rubber gasket, and the bell shall be lubricated with a soft, vegetable compound. After lubrication, the gasket shall be thoroughly stretched when placing in the spigot groove so that there is a uniform volume of rubber distributed around the circumference. The gasket shall not be twisted, rolled, cut, crimped or otherwise injured or forced out of position during closure of the joint. Prior to assembling the joint in position, metal or wooden spacers shall be placed against the inside shoulder of the bell to provide the proper space for mortar between abutting ends of the pipe. After the joint is assembled, a "feeler" gauge shall be inserted between the bell and the spigot and the position of the

rubber gasket checked around the complete circumference of the pipe. If the gasket is not in the proper position, the pipe shall be withdrawn, the gasket checked to see that it is not cut or damaged, the pipe relaid, and the gasket again checked.

Where indicated on the Plans and at locations where make-up field joints are required, the pipe shall be joined by lap welded field joints. Welded field joints at locations where a bell end is not provided shall be made by means of a bell end formed by a 4-inch butt strap welded to one side of the joint prior to assembly. All welding of field joints shall be in accordance with the requirement of AWWA Specification C 206.

Where welding is required in the field for pipe restraints in accordance with the Plans or Specifications, the welded surface shall be given an SP-3 power tool cleaning in accordance with the Specifications of the Structural Steel Painting Council. Following power cleaning, the Contractor shall recoat the power cleaned areas with an acceptable coating furnished by the pipe manufacturer and equal to the material and thickness supplied on the pipe by the pipe manufacturer. Following application of the coating, the pipe joint shall be grouted as specified hereinafter.

After the pipe has been laid, and before trench backfill may commence, the outside annular space between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of the joint shall be completely protected with cement grout. Grout used for filling the outside joints by the pouring method shall be mixed in proportions of one part cement by weight, to not more than one part, by weight, of sand passing a No. 16 mesh screen and thoroughly mixed with water to the consistency of rich cream. A band of canvas or polyethylene shall be placed around the outside of the pipe and centered over the joint. The joint band shall be bound to the pipe by use of steel box strapping. The band shall completely and snugly encase the joint except for an opening at the top through which to pour the grout. The outside grout space, prior to filling with grout, shall be flushed with water so that the surfaces of the joint to be in contact with the grout filling will be thoroughly moistened when the grout is poured. Fluid grout shall be poured in only one opening in this joint and pouring shall be continuous until grout appears at the other side. The grout shall be rodded on both sides of the pipe to settle the grout and more grout added, as necessary, to fill the joint completely. Exposed portions of the joint, after filling, shall be covered with wet burlap. Joint bands shall not be removed.

Backfilling shall not be started until the exterior joint protection grout has set (2 hours) and the Inspector has checked and accepted each joint as completed.

After trench backfill is complete, the interior joint recesses shall be filled with mortar, tamped into the joint with a thin block of wood or other suitable tool, and pointed. The finished joint shall be smooth and flush with the adjacent pipe surfaces. Mortar for the inside of pipe joints shall be mixed in the proportion of one part, by weight, of cement,

to two parts, by weight, of clean well-graded sand, and just sufficient water shall be used so that the resulting mortar will crumble to the touch after being "balled".

All mortar or grout shall be newly mixed. No mortar or grout that has begun to set shall be used, and no retempering will be allowed.

150022.10 CURING AND PROTECTION OF JOINTS

Joints requiring mortar or grout shall be cured and protected as follows: Immediately after each exterior joint is completed, if not already by canvas or polyethylene band, it shall be protected from the sun by means of a covering of wet burlap and an initial covering of fine, moist earth or sand approximately 6 inches above the top of the pipe. Extreme care shall be taken in placing such earth around the pipe to avoid injury to freshly applied mortar or grout. At the close of the day's work and at such other times when the pipe is not being laid, if the inside joints are pointed, all openings in ends of the pipeline shall be covered by sacks and moist earth or sand to prevent drying out of the joint mortar by the circulation of air within the pipe.

150023 STEEL SURFACES EXPOSED TO WATER OR EARTH

All steel surfaces exposed to water or earth, including but not limited to blind flanges used in access manholes, construction manholes, bell rings at structures, all cast-iron or steel nuts and bolts, and dead ends shall be painted with an epoxy polyamide system of 10 mils dry film thickness conforming to the requirements of the FDA, Section 175.300 for potable water. The epoxy polyamide system used shall be as manufactured by Glidden, Tnemec, or equal, applied in accordance with the paint manufacturer's recommendations, to a clean surface, free of dust, dirt, mill scale, rust, oil, or grease, commercial blasted cleaned in accordance with SP-6, Steel Structures Painting Council Specifications.

150025. LAYING OF DUCTILE IRON PIPE

Trenching, bedding, and backfill shall be in accordance with MAG Uniform Standard Specifications, Section 601.

The handling, storage, and installation of ductile iron pipe shall be in accordance with the requirements of these Specifications and AWWA C 600.

150027. LAYING OF PVC PIPE OR CPVC PIPE

Trenching and backfill shall be in accordance with MAG Uniform Standard Specifications, Section 601.

The handling, storage, bedding, and installation of PVC pipe shall be in accordance with the manufacturer's recommendations and ASTM D 2774.

150030 CLEANING AND TESTING

The interior of all pipelines, above or below grade, shall be thoroughly cleaned of all adhering matter and other debris. No testing of any pipeline shall be started until the cleaning is complete and accepted by the Engineer.

Special precautions required in the cleaning of a particular pipeline shall be as stated in the various parts of this Division of these Specifications.

All pipelines, above or below grade, shall be tested to the pressures indicated in the various parts of this Division of these Specifications. Any piping for which test pressure is not specified shall be tested under a pressure of 25 psi above the operating head.

Pipe underground may be tested before backfilling unless otherwise specified, and pipes to be encased in concrete or under concrete slabs shall be tested before the encasement or slabs are placed.

The Contractor shall furnish all necessary personnel, supplies, equipment, bulkheads, and whatever additional equipment is required to make any and all tests specified and shall make any and all repairs, including relaying, if necessary, to any and all pipelines failing to pass the testing requirements of these Specifications.

The Contractor shall give the Engineer a list of the scheduled pipeline tests by noon of the day preceding the scheduled test or tests. The Contractor shall notify the Engineer by written memorandum of his readiness (not just his intention) to test a line or portion of line. All bulkheads, thrust blocks, anchors, temporary connections, pumps, etc., shall be in place before the Contractor's notification of readiness is given to the Engineer. After testing, all pipes shall be flushed or blown out and left clean.

In testing with water, the test pressure specified shall be the pressure at the lowest point in the piping concerned. In testing with water, the lines shall be examined and any visible leaks repaired. In testing with air, the lines shall be examined and tested with soap suds and any leaks repaired. Testing shall be repeated until the lines are in satisfactory condition.

Despite any previous testing, any leaks developing before the end of the one year guarantee period shall be repaired by the Contractor at no additional expense to the Owner.

150033 LIQUID PIPING TESTS

All liquid piping shall be tested with water at the pressure specified.

150036. POTABLE WATERLINES

Potable water pipelines shall be disinfected in accordance with MAG Uniform Standard Specifications, Section 611.

150060. PIPING SCHEDULE

Where not specifically noted on the Plans or otherwise specified, pipe shall be installed in accordance with the following schedule.

Pipe listed as "aboveground" shall include that within buildings, tunnels, or other structures without regard to its elevation. "Underground" piping shall be taken to mean only that piping actually buried in the soil or cast in concrete masonry. "Underwater" piping shall mean piping which extends below tops of walls or concrete deck into basins or concrete tanks containing water.

The Contractor may, at his expense, furnish piping of the same material as shown in the PIPING SCHEDULE but of greater pressure rating than that specified.

Where bell and spigot joints are indicated on the Plans or specified, mechanical joints or push-on joints may be used.

The Contractor is responsible for furnishing and installing all necessary piping to make all equipment and other parts of the plant functional. Should the type of pipe for a given use be not indicated, the following paragraphs shall serve as a guide with the acceptance of the Engineer in the selection of the proper pipe to use for a given service.

Air, oil, and gas piping may be steel pipe. Steel pipe under 4 inches in size shall be galvanized. Steel pipe 4 inches and over in size shall be black. All gas pipe shall be pitched to drain to drip traps as indicated, not less than 1/8 inch per foot where condensate flows against the gas and not less than 1/16 inch per foot where condensate flows with gas. At high points of straight runs, tapered filler pieces between flanges shall be used to secure the reversal of pitch without springing the pipe.

Culvert pipe may be corrugated metal pipe or concrete pipe.

PIPING SCHEDULE

<u>Use</u>	<u>Inside Diameter Inches</u>	<u>Piping</u>	<u>Joints/ Fittings</u>	<u>Test Pressure</u>
Water Main aboveground	66	Fabricated steel cement mortar lined	Welded	30 psi
Water Main underground	66	Fabricated steel cement mortar lined concrete encased	Welded	30 psi

PIPING SCHEDULE, CONT'D

<u>Use</u>	<u>Inside Diameter Inches</u>	<u>Piping</u>	<u>Joints/ Fittings</u>	<u>Test Pressure</u>
Water Main underground	66	Prestressed concrete cylinder, AWWA C-301	Steel-Rubber gasketed, welded	30 psi
Water Main aboveground	60	Fabricated steel cement mortar lined	Welded	55 psi
Water Main underground	60	Fabricated steel cement mortar lined concrete encased	Welded	55 psi
Raw Water aboveground	66	Fabricated steel cement mortar lined	Welded	65 psi
Raw Water underground	66	Fabricated steel cement mortar lined concrete encased	Welded	65 psi
Raw Water aboveground	48	Fabricated steel cement mortar lined	Welded	80 psi
Raw Water underground	48	Fabricated steel cement mortar lined concrete encased	Welded	80 psi
Drain	48	Reinforced concrete, ASTM C-76	Rubber gasketed	20 ft.
Plant I Wash Water above- ground	36	Fabricated steel cement mortar lined	Welded	20 ft.
Plant I Wash Water under- ground	36	Fabricated steel cement mortar lined concrete encased	Welded	20 ft.
Plant II Wash Water above- ground	36	Fabricated steel cement mortar lined	Welded	20 ft.
Plant II Wash Water under- ground	36	Fabricated steel cement mortar lined concrete encased	Welded	20 ft.
Plant II Wash Water under- ground	36	Reinforced concrete, ASTM C-76	Rubber gasketed	20 ft.

CONSTRUCTION SPECIAL PROVISIONS
CONTRACT NO. FCD 88-40

PIPING SCHEDULE, CONT'D

<u>Use</u>	<u>Inside Diameter Inches</u>	<u>Piping</u>	<u>Joints/ Fittings</u>	<u>Test Pressure</u>
Raw Water Pump out access	12	Fabricated steel cement mortar lined and coated	Flanged	65 psi
Potable Water aboveground	See Plans	Ductile-iron Class 52, Sch. 40 copper	Flanged, soldered	150 psi
Potable Water underground	See Plans	Ductile-iron Class 52	Mechanical joint	150 psi
Chemical lines aboveground	See Plans	Stainless steel	Welded	150 psi
Chemical lines underground	See Plans	PVC, Schedule 80	Solvent Weld	150 psi

150070 CONNECTION TO IN-SERVICE LINES

Existing pipe to which connections are to be made shall be exposed by the Contractor to permit field changes in line, grade, or fittings, if necessary.

All connections to existing lines shall be constructed according to the Plans.

When shutdown of an in-service line is necessary in order to connect to the new lines, a conference between the Contractor's representative, the Engineer, and operating supervisory personnel shall establish the time and procedures to insure that the shutdown will be for the shortest possible time. If necessary, shutdowns may be scheduled during other than normal working hours, at no additional cost to the Owner.

150100. DUCTILE-IRON PIPE

Wherever cast-iron pipe is called out on the Plans, or specified herein, ductile-iron pipe shall be used in its place.

Ductile-iron pipe shall conform to the requirements of ANSI A 21.50 and ANSI A 21.51 (AWWA C 150 and AWWA C 151). Ductile-iron pipe fitted with threaded flanges shall conform to ANSI 21.15 (AWWA C 115). Unless indicated otherwise on the Plans, ductile-iron pipe class thickness shall be as required to support earth and live loads. Earth loads shall be calculated using the formula $W = 170 H B_c$. H is the height of the fill over the pipe in feet and B_c is the outside diameter of the pipe in feet. H-20 loading shall be added to the earth loadings.

The manufacturer shall submit design calculations to the Engineer for review and acceptance. The design calculations shall indicate the pipe wall thickness that will be satisfactory for all conditions of external pressure and earth loadings, special physical loadings, and internal pressure.

Ductile iron pipe shall be as calculated above, and as indicated on the Plans or in the Piping Schedule, but in no case shall be less than Class 51.

150101 GROOVED-END DUCTILE-IRON PIPE - GENERAL

Grooved-end pipe with mechanical pipe couplings (victaulic type) and fittings may be installed in place of flanged systems at certain locations and in certain services on this project. Grooved-end pipe shall not be used underground or underwater unless indicated otherwise on the Plans. Grooved-end pipe shall not be used for systems which may be steamed.

Pipe and fittings shall be cut grooved. Method of grooving shall be in accordance with mechanical pipe coupling manufacturer's specifications. Pipe to be grooved shall have wall thicknesses not less than the minimum recommended by the coupling manufacturer for cut-grooving and AWWA C 606. Connections to valves and flanged-end pipe shall be by grooved-end to flanged pipe adapter flange or flanged adapter nipple. Grooved pipe and fitting ends shall be lightly coated with lubricant approved by the coupling manufacturer prior to placing gasket.

Grooved-end pipe shall be supported in accordance with manufacturer's recommendations. In addition, at least one support shall be used between any two couplings.

The Contractor shall submit for review a listing of services and locations where he proposes to use grooved-end pipe prior to start of installation of any grooved-end piping. This listing is subject to the Engineer's acceptance and acceptance must be granted in writing by the Engineer prior to the delivery of any grooved piping materials to the jobsite.

The Contractor shall submit for review complete information showing fittings, gaskets, mechanical pipe couplings, grooving of pipe and pipe lining or coating prior to installation of any pipe. All materials proposed for use are subject to the Engineer's acceptance.

Mechanical pipe couplings and grooved-end pipe shall be installed in accordance with the coupling manufacturer's representative's recommendations.

150102 GROOVED-END DUCTILE-IRON PIPE COUPLINGS

Grooved-end ductile-iron pipe shall be joined by mechanical pipe couplings. Mechanical couplings shall be self-centering and shall engage and lock in place the grooved pipe and pipe fitting ends in a positive watertight couple. Couplings shall be fabricated in two or more parts of

malleable iron in accordance with ASTM A 47, Grade 32510. Couplings shall be the rigid grooved type, conforming to AWWA C 606 and as specified herein.

Coupling assembly shall be securely held together by two or more steel bolts and nuts of heat-treated carbon steel. Nuts and bolts shall be in accordance with ASTM A 183 and A 194, Grade 2.

Couplings shall hold in place a composition water-sealing gasket designed so that internal water pressure serves to increase the seal's watertightness. Sealing gaskets shall be chlorinated butyl in accordance with ASTM D 2000, Grade No. 3BA615A14B13Z with special heat-resistance test of 16 hours at 350 degrees F and maximum elongation change of minus 30 percent.

All pipe fittings used in connection with mechanical pipe couplings shall be radius grooved for grooved-end ductile-iron pipe. Radius grooved ductile-iron fittings shall conform to the requirements of ANSI B 16.1. The outside surface of pipe between the groove and pipe end must be smooth and free from deep pits or swells and shall provide a leaktight surface for the gasket.

150110. JOINTS

Where so indicated or specified, joints shall be made with flexible couplings or with mechanical couplings for grooved-end pipe. Unless otherwise noted, joints that are not buried in the ground and those that are indicated on the Plans or in the Specifications to be flanged shall be flanged joints. Push-on joints may be used on low head, gravity drain lines. All other joints shall be mechanically restrained mechanical joints. Only restrained joints using retainer glands with lugs, megalug or equal; integral mechanically restrained push-on joints; or lugged type joints with 304 stainless steel tie rods and nuts shall be used. If field welding of the retainer weldment on the push-on type joints is required, the Contractor shall present evidence to show that the welder has been certified at the factory to do field welding of retainer weldments. Mechanically restrained joints shall be able to withstand the test pressure of the pipeline. Concrete thrust blocks shall be used only when specifically detailed or accepted by the Engineer. Mechanical joint, or push-on joint pipelines shall have flanges where necessary for valves and clean-out connections.

150111. FLANGED JOINTS

Flanges may be cast integrally with the pipe, in which case they shall conform to ANSI B 16.1 as to diameter, thickness, drilling, etc., or they may be screwed on the threaded ends of the pipe. Screwed-on flanges shall conform to ANSI B 16.1 (AWWA C-115) as to material, diameter, thickness, drilling, etc., but shall have long hubs threaded specially for ductile-iron pipe. Screwed-on flanges shall be attached to the pipe by the pipe manufacturer, and after attachment the faces of the flanges and the ends of the pipe shall be refaced so that the end of the pipe will be even with

the face of the flange and both will be perpendicular to the axis of the pipe. Bolt holes on the 2 flanges on a piece of pipe shall be in perfect alignment. Bolts shall conform to ANSI B 16.1.

Flanges for ductile-iron pipe shall be ductile iron.

Where cap screws or stud bolts are required, flanges shall be provided with tapped holes for such cap screws or stud bolts.

Gaskets shall be full face or ring gaskets of 1/8-inch thick cloth inserted neoprene.

All flange bolts shall be cut and finished to project not less than two threads, and not more than 1/4-inch beyond outside face of nut after joint is assembled.

150112. MECHANICAL JOINTS

Mechanical joints shall be in accordance with ANSI A 21.11 (AWWA C 111), and shall be mechanically restrained.

150113 PUSH-ON JOINTS

Push-on rubber gasket joints shall be in accordance with ANSI A 21.11 (AWWA C 111).

150120 FITTINGS

Except as otherwise provided, fittings for ductile-iron pipe shall be as specified in ANSI A 21.10 (AWWA C 110), of the same pressure rating as the pipe with which they are used.

150121 PUSH-ON

Push-on rubber gasket joint fittings shall have bodies as specified above with bells dimensioned and arranged to match the push-on joints on the pipe.

150122 FLEXIBLE FITTINGS

Flexible fittings applicable to ductile-iron pipe shall be as specified under the PIPING SPECIALTIES section of these Specifications.

150130. LINING AND COATING

Except as otherwise specified, all ductile-iron pipe and fittings shall be smooth cement lined in accordance with ANSI A 21.4 (AWWA C 104). Special attention shall be given to the lining of fittings. Lining shall be applied to bare metal. All lining shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.

In addition, all ductile-iron pipe and fittings shall be coated inside and outside with bituminous material except that pipe which is to be painted shall not be coated on the outside.

Pipe used as casing for chemical lines shall not be lined on the inside.

Where flanges or grooved-end couplings are buried, they shall be coated with a coal-tar mastic as specified in DIVISION 9.

150140 HANDLING OF PIPE AND FITTINGS

All ductile-iron pipe shall be carefully handled during loading, unloading, and installation. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or cement lining. Any broken or chipped lining shall be carefully patched. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use.

All mechanical joint pipe shall be laid with 1/8-inch space between the spigot and shoulder of the pocket.

150160 CORROSION PROTECTION

Ductile-iron pipe buried in soil shall be protected against external corrosion by loose polyethylene sleeves in accordance with AWWA C 105.

150170 TESTING

All pipelines for which testing is not otherwise specified shall be tested for watertightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with applicable provisions of AWWA C 600, except as modified below. The Contractor shall provide all vents, piping, plugs, bulkheads, valves, bracing, blocking, pump, measuring device, and all other equipment necessary for making the tests, except pressure gauges. The Owner will furnish the water required for the first test, if more than one test is required, the Contractor shall pay for the water required to make the additional tests. Each section of a new line between sectionalizing valves or between the last sectionalizing valve and the end of the project shall be tested separately as required in AWWA C 600, and/or as modified in these Specifications, except that any such section less than 500 feet in length may be tested with the adjacent section, if both sections of line have the same pipe class rating. The duration of each test shall be at least 2 hours.

150171. PRESSURE TEST

All pipelines shall be tested by subjecting each section to a pressure, measured at the lowest end of the section, as indicated on the Piping Schedule.

The test may be made before or after backfilling. However, if mechanical compaction is to be used in the backfilling operations as spelled out in AWWA C 600, the test shall not be made until the backfilling is completed and compacted. All connections, blowoffs, hydrants, and valves shall be tested with the main as far as is practicable.

The test section shall be slowly filled with potable water, and all air shall be vented from the line. The rate of filling shall be as acceptable to the Engineer, with at least 24-hour notice required before tests are scheduled. While the test section is under test pressure, a visual inspection for leaks shall be made along the pipeline, and all visible leaks repaired. The pressure test shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption.

150172. LEAKAGE TEST

Leakage test shall be made after pressure test has been satisfactorily completed and all backfilling and compaction is completed to top of trench. The Contractor shall furnish the necessary apparatus, and assistance to conduct the test.

To pass the leakage test, the leakage from the pipeline shall not exceed the leakage allowed by the following formula:

$$L = \frac{ND \sqrt{P}}{3700}$$

in which L = allowable leakage in gallons per hour.

N = number of joints in the pipeline being tested, this "N" being the standard length of the pipe furnished divided into the length being tested, with no allowance for joints at branches, blowoff, fittings, etc.

D = nominal diameter of pipe in inches.

P = average observed test pressure of the pipe being tested, equal to at least 100 percent of the class rating of pipe being tested, in pounds per square inch gauge, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.

Should the test on any section of the pipeline show leakage greater than specified above, the Contractor shall locate and repair the defective pipe, fittings, or joint until the leakage is within the specified allowance of 2-hour duration. All repairs and retests, if required, shall be made without additional cost to the Owner.

Connections to the existing pipelines or existing valves shall not be made until after that section of the new construction has satisfactorily passed the hydrostatic tests and has been sterilized and flushed, where required.

150200. STEEL PIPE

Except as otherwise specified or indicated on the Plans, steel pipe and fittings shall be as follows.

Steel pipe 12 inches and smaller in nominal diameter shall be seamless or straight seam electric resistance welded pipe conforming to the requirements of ASTM A 53 or ASTM A 120. Pipe 6 inches and smaller shall be Schedule 40. Pipe over 6 inches but not larger than 12 inches shall be no lighter than Schedule 20.

Steel pipe over 12 inches in nominal diameter shall be in accordance with AWWA C 200, except that butt strap, riveted, or swaged joints may not be used. Pipe over 12 inches in diameter shall have a wall thickness of not less than 1/4-inch to 72-inch diameter and 5/16-inch over 72-inch diameter, unless indicated otherwise on the Plans. All pipe shall be black unless indicated otherwise on the Plans or specified to be galvanized. If galvanized, it shall be galvanized in accordance with ASTM A 120. The working stress for any of the steels specified as acceptable for fabrication of pipe shall not exceed 50 percent of the yield point of the steel used.

Wherever flexible (Dresser or Victaulic) couplings are to be used on pipe 24 inches in diameter, or over, having a wall thickness of less than 1/2-inch, stub ends not less than 6 inches long and 1/2-inch in thickness shall be provided for insertion into the couplings.

150210. JOINTS

Steel pipe joints shall be screwed, welded, flanged, or flexible joints as is appropriate to the pipe size and application, except that galvanized pipe shall not be welded. Welding shall be in accordance with AWWA C 206.

Unions shall be railroad type with bronze-to-iron seat, galvanized if used with galvanized pipe. Flanged joints may be used instead of unions.

Unless otherwise specified or indicated on the Plans, pipe joints shall be of the type specified below. Pipe smaller than 2 inches shall have screwed joints or flexible couplings. Pipe 2 inches through 4 inches shall have screwed, flanged, or welded joints, or flexible couplings. Pipe larger than 4 inches shall have flanged or welded joints or flexible couplings.

Threading shall be done with clean, sharp dies. Pipe threads carelessly made, wavy, rough, or chewed shall be rejected. All screwed joints shall be tightly and neatly made up with an application of Teflon tape or acceptable paste compound applied to the male threads only, except that liquid and dry chlorine lines and liquid LPG lines shall be made up with litharge and glycerine.

Flanges shall come together at the proper orientation with no air gaps between the flanges after the gaskets are in place. The fit shall not be made by springing any piping, nor shall the orientation alignment be

corrected by taking up on any flange bolts. Flange bolts shall slip freely into place with absolutely no binding. If the proper fit is not obtained, the piping shall be altered. Machined flanges or tapered fillers shall be used to accomplish changes in grade or to slope lines for drainage.

All welded joints shall be electric welded. Welding shall be in accordance with AWWA C 206. Qualification of welders shall be as covered in AWWA C 206. All testing of welders shall be at the Contractor's expense, including cost of test nipples, welding rod, and equipment.

150220. FITTINGS

Fittings used with screwed pipe shall be 150 pound malleable iron banded screwed fittings in accordance with ANSI B 16.3, galvanized in accordance with ASTM A 153 if used with galvanized pipe, or cast-iron drainage screwed fittings in accordance with ANSI B 16.12, galvanized in accordance with ASTM A 153 if used with galvanized pipe. Drainage fittings shall be used with drain lines, and other lines which are required to be graded.

Flanged fittings 12 inches and smaller shall be 125 pound cast-iron flanged fittings in accordance with ANSI B 16.1 or 150 pound steel flanged fittings in accordance with ANSI B 16.5. Flanged fittings for pipe larger than 12-inch may be as above or may be fabricated from sections of steel pipe in accordance with AWWA C 208, with flanges as specified in AWWA C 207.

Companion flanges 4 inches and smaller may be 125 pound screwed cast-iron companion flanges in accordance with ANSI B 16.1 or 150 pound slip-on or welding neck steel flanges in accordance with ANSI B 16.5, except that ammonia type flanges shall be used on chlorine liquid or gas piping. Companion flanges for pipe from 4 inches to and including 12 inches shall be slip-on or welding neck flanges in accordance with ANSI B 16.5.

Companion flanges for pipe larger than 12 inches may be as above or may be steel plate or raised hub flanges in accordance with AWWA C 207.

Slip-on flanges shall be attached to pipe by two fillet welds, in accordance with AWWA C 207. Welding neck flanges shall be secured by full penetration butt welds without backing rings. After welding in place, the faces of flanges shall be perpendicular to the axis of the pipe, or, in the case of fittings, at the proper angle to each other, and bolt holes shall be in proper alignment. Flanges shall be shop welded to pipe or fittings before lining is applied.

Machined flanges or tapered fillers shall be used to accomplish changes in grade, or to slope lines for drainage.

Flange bolts shall be in accordance with ANSI B 16.1.

All flange bolts shall be cut and finished to project not less than two threads and not more than 1/4 inch beyond outside face of nut after joint

is assembled. Where cap screws or stud bolts are required, flanges shall be provided with tapped holes for such cap screws or stud bolts.

Gaskets shall be ring gaskets of 1/16-inch long fiber asbestos composition suitable for temperatures up to 750 degrees F.

Welding fittings for pipe 8 inches and smaller in size shall be butt-welding fittings in accordance with ANSI B 16.9, standard wall or standard weight. Welding fittings for pipe larger than 8 inches shall be butt-welding fittings in accordance with ANSI B 16.9, or may be made up out of sections of pipe welded together, except where smooth bends are indicated in air lines. Fittings made up of sections of pipe welded together shall be made of pipe of at least the same wall thickness as the pipe with which used, and bends shall be miter bends, fabricated in accordance with AWWA C 208. Welding of these made-up fittings shall be in accordance with AWWA C 206.

150230 LINING

Except as otherwise provided, lining in steel pipe shall be as follows.

150231. CEMENT MORTAR LINING

Steel pipe specified or indicated on the Plans to be cement mortar lined may be shop lined in accordance with AWWA C 205.

150240. PIPE COATING

Aboveground steel pipe shall be painted as provided in DIVISION 9 of these Specifications.

Except as otherwise provided, all buried steel pipe shall be protected by the following coating systems applied in strict accordance with the manufacturer's instructions.

Pipe coating shall extend 6 inches above finish grade or finish floor, and shall be neatly terminated.

Before coating, pipe surface shall be free of dust, dirt, loose rust, moisture, welding residue, oil, and grease. Surface shall then be power tool cleaned or commercial blast cleaned to conform to SSPC Specification SP-3 or SP-6.

Where flanges or grooved-end couplings are buried, they shall be coated with an coal-tar mastic as specified in DIVISION 9.

150241. CEMENT MORTAR COATING

Steel pipe specified or indicated to be cement mortar coated shall be coated in accordance with AWWA C 205 modified as follows:

Portland cement shall conform to ASTM C 150 Type II, low alkali.

Sand shall conform to the requirements of AWWA C 205 except that the total percentage of all deleterious material shall not exceed 3 percent by weight.

150260. FABRICATED STEEL PIPE HEADERS

This portion of the Specifications covers the design, fabrication, and installation of all fabricated steel pipe headers and steel pipe assemblies.

All sections shall be shop fabricated in units that are as long as practicable for safe hauling and installation in order to minimize the number of field welds.

Piping shall be fabricated to uniform lengths with proper end clearance for welding or other types of joints as specified. All pipe and fittings shall make up without field cutting or special work.

The Contractor and fabricator shall design and detail the reinforcement of all openings in the headers and where pipe branches are attached. All openings or outlets in headers shall be reinforced in conformance with the ASME Code for Unfired Pressure Vessels and current revisions.

In designing pipe and reinforcing for openings (nozzles and elbows on headers or pipe attached to other pipe) the design working pressure or test pressure in the headers and piping shall be as specified.

Flanges for all fabricated steel headers shall be as specified for companion flanges herein for steel pipe.

Dished heads on 84-inch diameter and smaller manifolds shall be 1 piece (seamless) spherically dished (torispherical) heads. Larger heads may be seamed.

The dish radius shall be the same dimension as the outside diameter of the head measured at skirt. The skirt face length shall be not less than 3 inches for any head. The heads shall be designed in conformance with the ASME Code for Unfired Pressure Vessels.

The thickness of all pipe, large elbows, and headers, except header nozzles, shall be not less than 5/16-inch for pipe 72 inches and larger and not less than 1/4-inch for all pipe smaller than 72 inches in diameter, unless indicated otherwise on the Plans.

Ninety degree elbows shall be of 5 piece design, and thickness of material shall conform to thickness of pipe or manifold shells specified herein. Ends of fittings to be welded to pipe shall be beveled for welding. Fittings shall conform in dimension to AWWA C 208 for Steel Water Pipe Fittings.

The fabricator shall submit to the Engineer for review and acceptance, and before fabrication, complete details of the headers, elbows, stiffeners,

nozzles, and heads, which details shall show the thickness and dimensions of all reinforcing plates and ribs, details of welds, and all other information required to assist the Engineer in checking the design of the completed manifolds and fittings.

Flanges shall not be welded to nozzles until the nozzles and reinforcements are completely welded to the header. All flanges shall be accurately spaced and aligned so that when all connections have been made there shall be no stress on the header, piping, or equipment, and all equipment shall be properly located and aligned.

No shop testing will be required on any of the manifolds or piping connected thereto. All manifolds shall be field tested as part of the pipe to which they connect.

150260.10 LIQUID SYSTEM PIPE HEADERS

After final field welding, the lining and exterior painting at and near the welded connections shall be completed. Any lining damaged as a result of welding heat, handling, or other causes shall be repaired or replaced. Surfaces to receive field lining and painting shall receive the same pretreatment as specified for the interior and exterior shop coatings.

Fabricated steel manifolds and pipe shall be coated on the inside with a cement mortar lining in accordance with AWWA C 205. Wire fabric reinforcing shall be used on manifolds 24-inch diameter and larger. This lining shall be protected during hauling, installation, and operation. Joints shall be finished as specified for pipe lining after field welding is done.

150290. STAINLESS STEEL PIPE

The Contractor shall furnish and install stainless steel pipe for all above ground chemical pipe and fittings as indicated on the Plans.

The material of construction shall be 304L stainless steel for all stainless steel piping. The wall thickness shall be Schedule 10. Unless otherwise specified, all pipe sizes indicated on the Plans are nominal. Pipe fabricator shall hold to Iron Pipe Size (I.P.S.) outside diameters.

Pipe, sizes up to and including 12 inches, shall be automatically welded using gas tungsten-arc procedures. Sizes under 4 inches shall be single butt-welded, 4 inches through 12 inches double butt-welded. Sizes through 12 inches shall be supplied in 10-foot and 20-foot lengths without intermediate butt-welds. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions. All pipe shall be round and true. Piping installed underground shall be concrete encased.

All fittings shall be welded with 304L filler metal. All elbows through 24-inch size shall be die formed and shall be automatically welded, using gas tungsten-arc procedures with inert gas backing. Tees, crosses, true Y's and laterals shall be nozzle welded, using manual shielded metal-arc

procedures and double welds. All reducers shall be cone type. Longitudinal welds on all fittings, except elbows, shall be accomplished by the same procedures as listed for pipe. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions. Fitting dimensions shall be in accordance with ANSI B16.9, and shall be terminated and dimensioned as indicated on the Plans. Stub ends shall be nonporous cast 304L stainless steel. Gasket and wetted surfaces of all stub ends shall be machined and shall be free of crevices, pits, cracks and protrusions. Backing flanges shall be cast steel, ASTM A 216, Grade WCA. Flanges shall be provided at all valves, tees, drip legs, and digester gas control and safety equipment locations.

Pipe spools shall be manually welded with 304L filler metal, using gas tungsten-arc procedures with internal gas purge where internal weld seams are not accessible. Where they are accessible, seams shall be welded both inside and outside, using manual shielded metal-arc procedures. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions. Unless otherwise indicated on the Plans, all spools shall be terminated with stub ends as described above and face-to-face dimensions shall be determined by pipe fabricator.

All pipe, fittings and spools shall be completely pickled and passivated by immersion in a nitric-hydrofluoric bath at the proper temperature and length of time to insure removal of all free iron, weld scale and other impurities and to insure the establishment of a passive surface.

Pipe fabricator shall supply low carbon steel bolt sets to match at all joints, unless otherwise specified.

Rubber expansion joints shall be multiple arch type with filled arches and control rods. The liner shall be natural rubber with cover material suitable for outdoor use. Rubber expansion joints shall be General Rubber style 1025, or equal.

The inspection of all welds shall be required. This shall be a visual inspection for crevices, pits, cracks, protrusions and oxidation deposits. Presence of any of these items found in the weld seams shall be considered as grounds for rejection of the joint.

150310 STEEL CYLINDER PIPE - PRESTRESSED

GENERAL: This Specification covers prestressed reinforced concrete water pipe, designed and manufactured in accordance with AWWA C 301, latest revision. Except as otherwise specified or indicated on the Plans, field joints shall be bell and spigot with a rubber gasket. Pipe may be lined cylinder pipe or embedded cylinder pipe at the option of the Contractor.

The pipe diameter, specified or called for on the Plans, shall be the inside diameter of the concrete section. An affidavit of compliance as specified in Section 1.10 of AWWA C 301 is required. A tabulated layout schedule in accordance with Section 1.5.2 of AWWA C 301 shall be submitted to the Engineer for review and acceptance.

Identification marks as specified in Section 1.6 of AWWA C 301 are required. The pipe manufacturer shall clearly stencil or mark at the top of the pipe on the outside surface of each pipe the following:

1. Name or trademark of manufacturer.
2. Date of manufacture.
3. Internal diameter in inches.
4. Number consecutively according to design schedule from initial station to end station.

The manufacturer shall submit design calculations to the Engineer for review and acceptance. The design calculations shall indicate the pipe wall thickness that will be satisfactory for all conditions of external pressure and earth loadings, special physical loadings, and internal pressure.

DESIGN: Fabricated steel plate for pipe specials and fittings shall be designed to limit deflection under the external load specified to D^2 (inches)/4000. When welded joints or flanged joints are called for on the Plans to restrain the pipe under hydraulic thrust, the cylinder and the attachment of joint ring or flange to the cylinder shall be designed for this stress.

Stress analysis of pipe shall be made using "Olander's" coefficients for a 90-degree bedding angle. Deflection of steel plate pipe specials, and fittings shall be calculated from "Spangler's formula" using a bedding constant, K , of 0.100, a constant, E' , of 700 and a deflection lag factor of 1.25. Reinforcement of fittings shall be designed in accordance with supplementary data contained in the AWWA Steel Pipe Design Manual M11.

Earth loads shall be calculated using the formula $W = 192 H B_c$. H is the height of fill over the pipe in feet and B_c is the outside diameter of the pipe in feet. H-20 loading shall be added to all earth loads.

The allowable combined load compressive stress in the concrete shall not exceed 45 percent of the 28-day strength.

The cylinder wall thickness shall be increased, as required, at all bends, fittings, and anchorage locations where thrust is to be transmitted by the pipe.

MATERIALS: Cement used in the manufacture of pipe shall conform to ASTM C 150, Type II, low alkali. Mill certificates shall be furnished in triplicate for each load of cement delivered.

Steel for manufacture of pipe shall conform to Sections 2.7, 2.8, 2.9 and 2.10 of AWWA C 301. Mill test reports and certificates for steel as specified in Section 1.9.3 of AWWA C 301 shall be submitted in triplicate.

Rubber gaskets shall conform to the following requirements:

Minimum tensile strength - ASTM D 412	2,000/2,700 psi
Minimum elongation - ASTM D 412	400/350%
Hardness Shore A - ASTM D 2240	50-65
Specific gravity - ASTM D 297	0.95 to 1.45 ±0.05
Compression set - ASTM D 395, Method B	20% maximum
Tensile strength loss - ASTM D 573, 96 hours, 70 degrees C air	20% maximum
Elongation loss - ASTM D 573, 96 hours, 70 degrees C air	20% maximum

Test reports shall be furnished in triplicate showing the physical properties of rubber used in gaskets.

FABRICATION OF PIPE: Joint rings for spigot ends for rubber gasket joints shall be Carnegie shape M-3818.

Flanges shall be Class "D" steel ring flanges in accordance with AWWA C 207. Where flanged valves are to be installed, the pipe flange shall match the valve flange. At flanged joints connecting to valves, a steel pipe section without rod reinforcing not less than 24 inches long measured from the face of the flange shall be provided. Cement mortar lining and coating shall be applied to the steel pipe section. Flanges and portions of joint rings which are exposed on the completed pipe shall be given a shop coat of primer. All flange bolts installed underground shall be stainless steel Type 304 or 316.

Specials and fittings shall be designed and fabricated in accordance with Section 4 of AWWA C 301 and in conformance with AWWA C 208, except bend radius may be 2.5 times the nominal diameter. Specials and fittings shall be furnished as required to provide a complete pipeline as indicated on the Plans. Specials and fittings not detailed on the Plans shall conform to the details furnished by the manufacturer and accepted by the Engineer.

150800 COPPER PIPE AND TUBING

Except as otherwise specified or indicated on the Plans, copper pipe and tubing shall be as follows: copper pipe for the conveyance of water or aqueous solutions shall conform to the requirements of ASTM B 88 as detailed below. Copper tubing for instrument air and other gases and liquids shall conform to ASTM B 280.

Copper lines shall be neatly supported as indicated on the Plans or at such intervals as to prevent sagging. Tube shall be cut square with hacksaw or disc cutter and shall be reamed full size and burrs removed. If necessary, a sizing tool shall be used to correct any distortion. The outside surface of the end of the pipe and the inside surface of solder fittings shall be cleaned with steel wool until the metal is bright. Soldering flux shall be applied to the cleaned surfaces of pipe and fittings in a thin, uniform, complete coating. After the pipe has been inserted in the fitting as far as it will go, the fitting shall be twisted

on the pipe to help spread the flux uniformly. The fitting shall be heated until it reaches the correct temperature to melt the solder. The flame shall then be removed and the solder applied to the edge of the fitting or to the solder hole in the fitting, if there is one, and the joint completely filled with solder. When the solder has congealed to a plastic state, the excess metal shall be removed with a cloth or brush. Joints shall not be quenched after soldering.

All copper lines shall be cleaned with high-pressure air after first disconnecting piping at instruments, filters, pressure reducers, valve operators, and other special devices.

All copper lines shall be tested in the same manner as the piping system to which they connect, except that instrument air lines may be tested by use of a halide torch or other device after charging the lines with Freon.

150810. ASTM B 88 TUBING

All exposed copper pipe or tubing conforming to ASTM B 88 shall be Type L hard-drawn, rigid, seamless copper water tubing.

Copper tubing buried in the ground or in plastic conduit shall conform to the same specification but shall be Type K soft-annealed.

Fittings for tubing less than 1/2 inch diameter shall be Hoke "Gyrolok," Crawford Fitting Company "Swagelok," or equal. Fittings for pipe or tubing 1/2 inch diameter and greater shall be solder type ANSI B16.23 cast brass or ANSI B16.29 wrought copper. Solder shall be ASTM B 32, Alloy Grade 95TA.

Copper pipe connected to ferrous pipe or valves, or other noncopper items shall be connected by means of dielectric insulating unions or fittings as manufactured by the Patrol Valve Company, Mueller Company, or equal.

150820 ASTM B 280 TUBING

Copper tubing shall be OD sized copper tubing with wall thickness of at least 0.030 inch, conforming to ASTM B 280, Type 122.

Fittings shall be solder fittings or brass flared fittings. Copper tubing may be bundled into groups of parallel or spirally cabled tubes within a plastic sheath.

150830 INSTALLATION

Copper tubing shall be installed in neat, straight runs, supported at close enough intervals to avoid sagging. All details indicated on the Plans shall be followed.

Cuts shall be made with a tubing cutter, or with a 32-tooth hacksaw, and shall be square. The inside of the tube shall be reamed and burrs removed from the outside, holding the end of the tubing downward during these

operations so chips or filings cannot fall into the tubing. Flaring shall be done with a flare block and yoke type screw feed flaring tool. After removing the tubing from the block, both surfaces of the flare shall be inspected for splits, cracks, or other imperfections; and if there are any imperfections, the imperfect flare shall not be used. In assembling the fittings, all contacting surfaces shall be thoroughly clean. Tubing shall not be sprung into place, and connections shall seat freely before sleeve nuts are tightened.

Copper tubing connected to meters, etc. shall be carefully graded in one direction. All lines shall be left clean.

151400. REINFORCED CONCRETE PIPE

Where reinforced concrete pipe is indicated on the Plans, it shall be in accordance with ASTM C 76 with Class as noted on the Plans. Cement used in the manufacture of pipe shall be in accordance with ASTM C 150, Type II, low alkali. At least two 3-edge bearing tests shall be made on each size and class of pipe. No hydrostatic nor absorption tests will be required except as stated hereinafter.

151410 JOINTS

Joints shall be the rubber gasket type with the gaskets in accordance with ASTM C 361. Connections of reinforced concrete pipe to plant structures shall be with steel manufacturer's bell ring as detailed on the Plans. Plastic or fiberglass bell rings or collars shall not be used. Rubber gaskets shall be of the O ring type. The spigot shall be formed with a groove for the gasket.

151420 FITTINGS

Fittings required as indicated on the Plans shall be constructed to the standards of the pipe manufacturer. Details of fittings shall be submitted for Engineer's acceptance before fabrication.

151430 CURVES

In general, horizontal or vertical curves shall be made by using pipe with beveled ends or by slight deflections in the joints of straight pipe. If necessary, short length pipe shall be made for curves of shorter radius than can be made with beveled pipe of usual length. Detailed layouts of curves shall be submitted to the Engineer by the pipe manufacturer for review and acceptance before fabrication of the beveled pipe. Curves may be made by use of angle bands at joints in lieu of beveled ends. Not more than 15 degrees of deflection angle shall be made in any one joint. Each angle joint shall fall upon the curve of the radius as indicated on the Plans.

151440 PIPE DELIVERY AND HANDLING

All pipe shall be manufactured, handled, loaded, and shipped in such a manner as to be delivered undamaged, in sound condition, and conforming in

all respects to these Specifications. Each section of pipe shall be plainly marked with the date of manufacture, D load, and top of pipe. Markings shall be scratched into the green concrete at both ends inside the pipe and shall be marked also on the outside of the pipe at the four quarter points.

151450 TESTING

After installation, all pipelines shall be left thoroughly clean. The lines shall be tested before complete backfilling by bulkheading the lower end of the pipe, filling the pipe gradually with water until there is a head of 2 feet more than the highest expected operating head. Each joint shall then be visually inspected and any leaks permanently repaired. Moist or sweating surfaces will not be deemed as leaks. If necessary, the pipe shall be overhauled, relaid, or collared with concrete until the joints hold satisfactorily. The Contractor shall furnish all necessary tools, labor, materials, water, bulkheads, and appliances needed for the test. Backfill at joints shall not extend above spring line before testing.

151800 PLASTIC PIPE, TUBING, AND FITTINGS

Except as otherwise specified herein, or indicated on the Plans, plastic pipe, tubing, and fittings shall be as follows.

Extruding and molding material shall be virgin material containing no scrap, regrind, or rework material except that, where permitted in the referenced standard specifications, clean rework material generated from the manufacturer's own operations may be used as long as the end product meets the requirements of this Specification. Pipe and tubing, except for drainage pipe, shall meet the requirements of the National Sanitation Foundation Testing Laboratories Inc. and shall bear the "nSf" seal.

All plastic pipe delivered to the jobsite shall be plainly marked as to nominal pipe or tubing size, type, class, schedule or pressure rating, and manufacturer.

Fittings shall be of the same material as the pipe and of equal or greater pressure rating, except that drainage waste and vent (DWV) fittings need not be pressure rated; and all fittings shall conform to the appropriate ASTM Specification. In general, fittings for rigid pipe shall be socket type for solvent or fusion welding, and fittings for nonrigid pipe shall be insert or flare fittings as specified or acceptable to the Engineer.

Transitions from plastic to metal or IPS pipe shall be by molded transition fittings, not by threading the plastic pipe. Unions 2-1/2 inches and smaller shall be socket end screwed unions, and unions 3 inches and over shall be made up of socket flanges with 1/8-inch full face soft rubber gasket. Unions shall be located where indicated on the Plans and elsewhere as directed by the Engineer for adequate access to the piping system for inspection and cleaning.

Nipples for transition from plastic pipe to rubber hose shall be serrated.

CONSTRUCTION SPECIAL PROVISIONS

CONTRACT NO. FCD 88-40

Page 80 of 103

151810 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PVC pipe shall be Schedule 40 or Schedule 80 as specified, PVC 1120, conforming to the requirements of ASTM D 1785 and appendices thereto. Pipe shall be extruded from Type I, Grade 1, Class 12454 material as specified in ASTM D 1784.

Fittings shall conform to ASTM D 2466 or D 2467 for pressure fittings, or to ASTM D 2665 for DWV fittings as is appropriate to the service and pressure requirement. Solvent for solvent welded fittings shall conform to ASTM D 2564.

151820 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

CPVC pipe shall be Schedule 40 or Schedule 80 as specified, conforming to ASTM F 441, CPVC 4120, conforming to the requirements of ASTM D 1785 and appendices thereto. Pipe shall be extruded from Type IV, Grade 1, Class 23447 material as specified in ASTM D 1784.

Fittings shall conform to ASTM F 438 or F 439 for pressure fittings, as is appropriate to the service and pressure requirement. Solvent for solvent welded fittings shall conform to ASTM F 493.

152100 PIPING SPECIALTIES

The Contractor shall furnish and install, wherever shown on the Plans, as called for in these Specifications, or as required for proper operation of equipment, all items specified under this heading including gaskets, bolts, calking materials, hangers, supports, guides, anchors, and such incidental materials and equipment as are required to make the items complete and ready for use.

152110. FLEXIBLE PIPE COUPLINGS

Where shown on the Plans or specified, or elsewhere as approved by the Engineer for the Contractor's convenience, flexible couplings shall be furnished and installed.

Flexible couplings shall be galvanized when on galvanized pipe or on pipe which is epoxy or cement lined, or when underground. When flexible type couplings are used as expansion joints, the ends of the pipe shall be separated to allow for expansion.

For cast-iron pipes, flexible couplings shall be Dresser Style 53; Rockwell International 431; Baker series 228; or equal.

For steel pipes, flexible couplings shall be Dresser Style 38; Rockwell International 431; or equal, except where other Styles are required for special conditions. Where indicated on the Plans, flexible couplings shall be suitable for connecting pipes which have different outside diameters.

For ductile iron pipe, flanged coupling adapters shall be Dresser Style 127, Rockwell International 112, Baker Series 600, or equal. For steel pipes, flanged coupling adapters shall be Dresser Style 128, Rockwell International 913, Baker Series 600, or equal.

Flanged coupling adapters shall be restrained with not less than 2 anchor pins each, installed in accordance with manufacturer's recommendations.

Where flexible couplings are installed underground, Type 316 stainless steel bolts shall be used. The entire coupling shall be coated with a coal-tar mastic per DIVISION 9.

Gaskets for all couplings except in the air piping system shall be neoprene rubber, or equal. Gaskets for couplings in the air piping system shall be suitable for operation at a temperature of 250 degrees F.

152135 PIPE SADDLES

Pipe saddles shall be furnished and installed where indicated on the Plans. Pipe saddles shall be Series 336 or 338 as manufactured by R. H. Baker & Company, Inc.; Style 304 as manufactured by Ford Meter Box Company, Inc.; or equal. Pipe saddles shall be Type 304 stainless steel with rubber gaskets. Threads on bolts shall have anti-gall coating. Size of the tapped boss shall be as indicated on the Plans.

153000. VALVES

The Contractor shall furnish all valves where indicated on the Plans, as called for in these Specifications, or as required for proper operation of the equipment in general. Unless otherwise indicated on the Plans or specified in other sections of these Specifications, valves shall conform to the requirements as specified herein.

All valves installed in a given line shall be designed to withstand the test pressure for that particular line and shall be fabricated with ends to fit the piping.

Valves shall be manufactured by a manufacturer whose valves have had successful operational experience in comparable service.

The valve manufacturer shall furnish detailed technical information as required by the Engineer for evaluating the quality of the valves and as required by the Contractor for proper valve installation. The technical information shall include complete dimensions, weights, and material lists. No valve will be accepted for installation until the required information has been received and reviewed.

The Contractor shall furnish four sets of complete installation operation and maintenance instructions for each type of valve furnished. Instructions shall be bound in a cover.

Wherever stainless steel is specified in this section, it shall be AISI Type 316, or 304 unless otherwise specified.

Bolts shall conform to ANSI B 16.1.

The zinc content of bronze or brass used in any valve parts shall not exceed 6 percent. The aluminum content of bronze shall not exceed 2 percent.

The method of connection of valves to each piping system shall be as detailed on the Plans. In general, unless otherwise indicated on the Plans or specified, all valves 3-inch size and larger shall have flanged ends or shall be designed for bolting to flanged pipe, and all valves less than 3-inch size shall have screwed ends.

The Contractor shall furnish to the pipe supplier, after flanged valves and flanged check valves are selected, the face-to-face dimensions of all flanged valves and check valves to be installed in flanged pipelines so that the pipe may be fabricated to the proper length.

All buried valves shall have cast-iron valve boxes. The boxes shall be asphalt varnished, or enameled cast iron, adjustable to grade, and installed perpendicularly, centered around and covering the upper portions of the valve or valve operator. The box shall not be supported in any manner by the valve, valve operator, or the pipe. The top of each valve box shall be placed flush with finish grade unless otherwise indicated on the Plans. Valve boxes shall be 2-piece Mueller Company, Tyler Pipe Industries Inc., or equal.

All buried valves and other valves located below the operating deck or level, specified or noted to be key operated, shall have an operator shaft extension from the valve or valve operator to finish grade or deck level, a 2-inch square AWWA operating nut, and cover or box and cover, as may be required.

Except as otherwise specified, all buried valves shall be painted with 2 coats of asphalt varnish in accordance with the requirements of AWWA Standard C 500. This protective coating shall be protected from damage until valve is backfilled.

Globe and gate valves shall be installed with stems horizontal or vertical above the pipe, except as specifically indicated otherwise.

All butterfly valves and plug valves above grade not specified to have geared operators shall be fitted with ell or tee wrench or handles for operation. Wrenches shall be secured to the valve head or stem except that if a wrench so secured constitutes a hazard to personnel it shall be stowed immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.

Where proper operation and utilization of equipment and facilities requires installation of valves not indicated or specified, the Contractor

shall provide and install, upon acceptance by the Engineer, valves similar and comparable to valves specified for similar and comparable duty in other parts of the project, without additional cost to the Owner.

153010 INSTALLATION OF VALVES

The Contractor shall furnish all labor, materials, and equipment necessary to install the valves complete in place at the locations indicated on the Plans in accordance with the details and these Specifications.

The Contractor shall furnish all incidental materials necessary for installation of the valves such as flange gaskets, flange bolts and nuts, valve boxes and covers, and all other materials required for the complete installation.

The Contractor shall provide the necessary concrete bases or supports and blocking to support the valves installed underground and aboveground.

Manually operated valves and gates located not more than 6 feet above the operating level shall be provided with tee handles, wrenches, or handwheels as is appropriate. Valves over 5 feet to center line shall be rolled toward the operating side to make the handwheel or wrench more accessible to the operator of average height. Valves located below the operating level or deck shall be provided with extensions for key operation or floor stands and handwheels as appropriate. Valves over 6 feet above the operating level shall be fitted with chain operated handles or valve wheels as appropriate. Chains shall reach to approximately 4 feet above the operating level. If, when not in use, chains constitute a nuisance or hazard to operating personnel, they shall be provided with hold backs or other means of keeping them out of the way. Valves shall be installed in all cases so that handles clear all obstructions when moved from full-open to full-closed position.

153200. GATE VALVES ABOVEGROUND

Gate valves under 3 inches in size for clear water and air service shall be 125 pound bronze, split wedge disc, rising stem, screwed end valves Crane No. 440, Jenkins Figure 62, or equal. Gate valves 3 inches in size and larger shall be flanged 200 pound iron body, bronze mounted, OS&Y double disc, parallel seat Mueller A-2483-6, Kennedy Figure 566, or equal, with stems of silicon bronze conforming to ASTM B 98, Alloy No. 661, or equal. Each valve shall be furnished with handwheel and shall open counterclockwise.

153210. GATE VALVES UNDERGROUND

Gate valves for buried installation shall be iron body, resilient seat, double disc, nonrising stem conforming to AWWA C 509 with double O-ring stem seal. Valves shall open counterclockwise. Valve ends shall be flanged, mechanical joint, or "Ring-Tite" joint as required for the type of pipe used.

153500 BALL VALVES

Where shown on the Plans, the Contractor shall furnish and install ball valves of the type and material shown or specified. Except as otherwise specified, all ball valves shall have TFE seats and TFE or Viton stem seals. Valves shall be suitable for working pressure not less than 150 psi. Stem packing shall be manually adjustable while valve is under pressure. Valves shall be nonlubricated, and capable of sealing in either flow direction.

153510 METAL BODY BALL VALVES

Except as otherwise specified, metal body ball valves shall be top entry valves as manufactured by Lunkenheimer, Hills-McCanna, or equal. Valves in copper lines shall be bronze body with solder ends. Valves in steel pipelines shall have ductile iron or cast steel bodies and threaded ends. Valves shall be suitable for -20 degrees F to +350 degrees F.

153700. HOSE VALVES

Where hose valves, other than fire hydrants or fire hose valves, are shown on the Plans or specified, they shall be as follows, or equals. Inlets shall be iron pipe thread, and outlets shall be American National 1-1/2 inch straight hose thread to match City of Phoenix standard hose connection. Nonfreeze box hydrants (street washers) and yard or post hydrants shall be set over a gravel filled drainage pocket not less than 2 cubic feet in volume. All hose valves except street washers shall have integral or nozzle type vacuum breakers.

153710 PLAIN HOSE VALVES

Hose valves not otherwise designated shall be Jenkins Figure 112, Crane No. 58, or equal angle hose valves. For yard hydrants they shall be mounted on 1-inch IPS risers with concrete splash blocks as detailed on the Plans. Each valve shall be provided with a nozzle type vacuum breaker.

153841. COMBINATION AIR-VACUUM RELEASE VALVES

The Contractor shall furnish and install combination air-vacuum release valves where indicated on the Plans, and specified herein. Combination air-vacuum release valves shall be Universal Air Valve, as manufactured by Multiplex Manufacturing Co., APCO, or equal. Valves shall be furnished with a screwed inlet fitting, and a Protectop. Valve bodies shall be cast-iron, and valves shall have a working pressure of not less than 300 psig. Size of valves shall be as shown on the air-vacuum and air release valve assembly detail.

154500. VALVE AND GATE OPERATORS

All valve operators other than T-wrenches or keys, and portable operators intended for operating more than one valve, or type of valve, shall be furnished by the valve or gate manufacturer as an integral part of the

valve or gate. All similar operators shall be of one manufacturer. All gates and hand operating lifts shall be of the same manufacturer. All hydraulic gate lifts shall be of the same manufacturer and shall be furnished with shop drawings through the manufacturer of the gates as completely integrated units.

Similarly all hydraulic valve operators shall be of one manufacturer, and all motorized operators shall be of one manufacturer, etc.

Operators for gates or valves having threaded stems that project above the operator as the gate or valve is opened shall have stem covers to cover the threaded portion of the greased stem. Stem covers shall be aluminum pipe with threaded cap on top and bolted aluminum flange on bottom. Slots, 1 inch wide and 12 inches long at 18 inches on center shall be cut in front and back of pipe. Flange, pipe, and cap shall be given an AA-A31 anodic treatment after fabrication.

After installation of the gate and stem cover, the stem cover shall be marked at the point where the top of the stem is at full-open position and where the top of the stem is at the closed position. Gate stem cover shall be plumb and shall be subject to the Engineer's acceptance.

All other operators shall have a means of determining the valve position. These may be tail rods on hydraulic cylinders, dial indicators calibrated in number of turns or percentage of opening, or other means acceptable to the Engineer. Dial indicators shall have the full-open and full-closed positions clearly indicated.

All manual or power operators shall be sized to deliver the maximum force that may be required under the most severe specified operating conditions including static and dynamic forces, seat and wedge friction, seating and unseating forces, etc., with a safety factor of 5 unless otherwise specified. All operators shall be capable of supporting the weight of any suspended shafting unless such shafting is carried by bottom thrust bearings. Shaft guides with wall mounting brackets shall be furnished and installed as required.

Where specified or indicated, crank or handwheel operated geared valve operators or lifts, shall be positioned and equipped for alternate operation by means of a tripod mounted portable gate operator.

Operators for all valves and gates shall turn counterclockwise to open and shall have an arrow and legend so indicating cast on the handwheel or chain wheel rim, crank, or other prominent place on the operator. All operators shall have suitable and adequate stops, capable of resisting at least twice the normal operating force, to prevent overrun of the valve or gate in open or closed position.

Buried operator housings for buried valves shall be oil and watertight, shall be specifically designed for buried service, and shall be factory packed with a suitable grease. The space between the operator housing and

the valve body shall be completely enclosed such that no moving parts are exposed to the soil. Operators for buried valves shall be furnished with a 2-inch square AWWA operating nut.

Gearing on worm gear operators shall be self-locking, and the gear ratio shall be such that a torque in excess of 160 foot pounds will not have to be applied to operate the valve at the most adverse conditions for which the valve is designed.

Traveling nut operators shall be designed such that a torque in excess of 100 foot pounds will not have to be applied to operate the valve at the most adverse condition for which the valve is designed. Limit stops shall be installed on the input shaft of all manual operators in the OPEN and CLOSED positions. The vertical axis of the operating nut shall not move as the valve is opened or closed.

154600. PIPE HANGERS AND SUPPORTS

The Plans do not, in all cases, show where or how pipe is supported; however, it is intended that all pipe and fittings shall be properly supported, suspended, or anchored as required to prevent sagging, overstressing, or longitudinal movement of certain piping, and to prevent thrusts or loads on or against pumps, meters, and other equipment.

Exposed piping shall be supported at the base of all risers, at intervals not to exceed 5 feet on all horizontal runs of pipe 2 inches and smaller, and at intervals not to exceed 10 feet on all horizontal runs of pipe larger than 2 inches. Piping 4 inches and larger through fill, backfill, or disturbed ground shall be supported at intervals not to exceed 10 feet with supports as detailed on the Plans. Plastic pipe and tubing, copper pipe and tubing, and rubber hose and tubing shall be supported at close enough intervals to prevent noticeable sagging, or shall be carried in trays.

All elbows to be supported from the floor shall be furnished and installed as base elbows, whether so indicated on the Plans or not. Supports for the base fittings shall be adjustable metal supports or concrete piers as indicated on the Plans. Riser clamps shall be Elcen Figure 29, Grinnell Figure 261, or equal.

Plastic pipe, valves, and headers shall be securely anchored to prevent any apparent movement during operation of valves. Plastic pipe shall be anchored between expansion loops and/or direction changes to provide for uniform expansion. Anchors and supports shall be in accordance with the manufacturer's published instructions.

Concrete pipe supports shall be cast where indicated on the Plans. Vertical corners shall be neatly chamfered. As a minimum of cradling, the concrete shall extend 1/4 of the pipe diameter above the pipe invert and at least 6 inches along the pipe shell.

Hanger rods, supports, clamps, anchors, expansion joints, brackets, and guides shall conform to the requirements of ANSI B 31.1 and the MSS Standard Practice SP-58 and SP-69; and shall be sized in accordance with the manufacturer's recommendation, or as indicated on the Plans.

Supports, clamps, clevises, brackets, or any devices bearing against copper pipe shall be copper plated, copper throughout, or insulated, except trays which shall be galvanized.

Where concrete supports are used under piping, the supports shall be poured 1-inch low, then the next day or later, the pipe grouted in place with nonshrink grout. Nonshrink grout shall be used under floor flanges to give level bearing. Floor flanges shall be bolted to the floor with at least 2 bolts, or as indicated on the Plans.

Special details are indicated on the Plans for special supports for heavy pipe and specials. Such supports shall be of heavy or sturdy design to carry the loads imposed thereon.

No use shall be made of chains, plumber's straps, wire, or other such devices for suspending, supporting, or clamping pipe of any size or type.

Brackets, supports, hangers, etc., shall be painted as specified in DIVISION 9.

The Contractor shall submit to the Engineer, for review and acceptance, a schedule of hanger, support, anchor and guide types and where they will be used prior to his assembling of any exposed piping.

154610. ANCHOR BOLTS AND INSERTS

Anchor bolts and concrete anchors shall be in accordance with Section 500 of MAG Standard Specifications.

Where indicated on the Plans, continuous concrete inserts, Unistrut Series P3200, or Elcen "Speed Strut" Figure 1150 of the lengths indicated or specified shall be furnished and installed. Where not otherwise indicated or specified, inserts in concrete ceilings and beam soffits may be malleable iron inserts, Grinnell Figure 152 or 282; Bergen-Patterson Part 108; Unistrut Series P3200; or equal. Wall and side beam inserts shall be Unistrut Series P3200, Elcen "Speed Strut" Figure 1150, or equal.

Support members shall be Unistrut Series P-1000, Elcen "Speed Strut" Figure 600, or equal.

Brackets shall be brackets of the model number as called for on the Plans, and made from Unistrut Series P-1000, Elcen "Speed Strut" Figure 600, or equal.

Channel inserts shall be installed in all tunnels below grade even under buildings at not more than five feet on centers. Channel inserts shall be installed in tunnel ceilings where indicated on the Plans at not more than

five feet on centers. Both wall and ceiling inserts shall be placed so that they are in line in tunnels ten feet and greater in width. In tunnels less than ten feet in width, the inserts shall be staggered at the midpoint spacing of the opposite wall. Channel inserts shall extend to within three inches of top of tunnel walls. Vertical channel supports installed opposite inserts shall extend to same height as inserts.

Under no circumstances will the use of Slugin or similar anchors relying on the deformation of a lead alloy or similar element for their holding power be permitted.

With the Engineers written permission, powder driven studs may be used for the securing of conduit and small pipe to structural metal, but their use will not be permitted in concrete, masonry, and similar materials.

154620. SINGLE PIPE HANGERS AND SUPPORTS

Single pipe hangers for pipe over 6-inch shall be adjustable clevis hangers, Bergen-Patterson Part 100; Grinnell Figure 260; or equal.

Single pipe hangers for pipes 6-inch and smaller may be as specified above or may be solid or split malleable iron rings, Bergen-Patterson Part 233 or 240; Grinnell Figure 104 or 101; or equal.

Single rod hangers for steam pipe shall be malleable iron or steel yoke and roller hangers, Elcen Figure 14 or 14A; Grinnell Figure 174 or 181; or equal.

Double rod steam pipe hangers, shall be Elcen Figure 15; Grinnell Figure 171; or equal.

154621. WALL OR CEILING CLAMPS

Pipe fastened against walls or ceiling shall be spaced out from the surface to allow the make up of unions, fittings, etc. For pipe larger than 2-inch, supports shall be offset pipe clamps, Elcen Figure 44; Bergen-Patterson Part 179; or equal. For pipe 2-inch and smaller, supports may be as above, or may be Unistrut standoff pipe clamps.

154630. TRAPEZE HANGERS

Use shall be made of trapeze hangers where indicated on the Plans or where several pipes are located at the same elevation in a horizontal plane. Unistrut, Speed Strut, or equal sections, fittings, etc., shall be as called for on the Plans.

154640. WALL BRACKETS

Wall brackets shall be fabricated steel, Bergen-Patterson Part 84; Grinnell Figure 195; Unistrut P2513, 2513A, or 2542; or equal.

DIVISION 16

ELECTRICAL

160100 GENERAL

It is the intent of this part of the Contract Documents to cover all work and materials necessary for erecting complete, ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and as hereinafter specified.

160101. GENERAL PROVISIONS

Minimum sizes of equipment, electric devices, etc., are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.

All work indicated on the Plans is approximately to scale, but actual dimensions and detailed drawings should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is directed since actual locations, distances, levels, etc. will be governed by field conditions.

Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the Engineer for a decision.

The alignment of equipment and conduit shall be varied due to architectural changes, or to avoid work of other trades, without extra expense to the Owner.

The Contractor shall furnish and install all parts and pieces necessary to the installation of equipment in accordance with the best practice of the trade and in conformance with the requirements of these Contract Documents.

All items not specifically mentioned in these Contract Documents or noted on the Plans or accepted shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

The Contractor shall lay out and install electrical work prior to placing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete.

The Contractor shall furnish and install all inserts and hangers required to support conduits and other electrical equipment. If the inserts,

hangers, sleeves, etc. are improperly placed or installed, the Contractor shall do all necessary work, at his own expense, to rectify the errors.

The Contractor shall submit shop drawings, data and details to the Engineer on all controls, fixtures, wiring, electrical equipment, conduit, etc. for review and acceptance prior to use of any components in the work.

160102 WORK INCLUDED

160103 REGULATIONS AND CODES

Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of the National Electrical Code (NEC), National Electrical Safety Code (NESC), State and local codes, and according to the latest Institute of Electrical and Electronic Engineers (IEEE); American National Standards Institute (ANSI); American Society for Testing and Materials (ASTM); Insulated Cable Engineers Association (ICEA); National Electrical Manufacturers Association (NEMA) Standards; National Electrical Contractors Association (NECA) Standard of Installation; and the latest published regulations of the Federal Occupational Safety and Health Act (OSHA). When applicable, the material used in the performance of the electrical work shall be approved by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

160105 TEMPORARY POWER

The Contractor shall furnish, install and maintain all temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the Contractor's main breakers and distribution system. Ground fault interrupting equipment shall be installed. All connections shall be watertight with wiring done with Type SO portable cable. After construction is completed, the Contractor shall remove all temporary power equipment and devices.

160106 CUTTING AND REPAIRING

Where it becomes necessary to cut into existing work for the purpose of making electrical installations, core drills shall be used for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the Engineer prior to starting the work.

The Contractor shall repair all damage caused thereby and restore damaged areas to original condition.

160107 CORROSION PROTECTION

Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the Contractor shall isolate these metals as required with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.

CONSTRUCTION SPECIAL PROVISIONS

CONTRACT NO. FCD 88-40

Page 91 of 103

Factory finishes damaged and/or rusting shall be restored to original new condition.

All electrical panels, switchgear, motor control centers, etc. shall be shipped in sealed dust and moisture-proof plastic sheet enclosures and the seal maintained until units are installed. Said units shall be in new condition, no dirt, dust, water, grease, rust, damaged parts, components, etc. All relay, starter, circuit breaker, switches, etc., contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, etc. before testing and energizing.

Once equipment is installed, it shall be protected at all times with plastic sheet covers until the area is secure from dirt, dust, workers, paint spray, water, etc. Heat shall be provided to eliminate condensation.

160109 TEST

The electrical work shall be free from improper grounds and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Individual circuit continuity checks shall next be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans or accepted drawings shall be corrected and indicated on the Plans.

160110 CONFORMS TO RECORD DOCUMENTS DRAWINGS

Prior to completion of the Contract, the Contractor shall furnish the Engineer with a set of electrical plans marked with any changes, deviations or additions to any part of the electrical work.

Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record documents drawings to enable rapid and accurate circuit tracing by maintenance personnel.

160111 SINGLE LINE DIAGRAMS

Single line diagrams, as indicated on the Plans, show circuit voltages, (4xx is 480V, 3xx is 277V, 2xx is 240V, 1xx is 120V circuits), wire and conduit sizes, circuit protection rating, and other pertinent data. Where conflicts exist on the Plans the single line diagrams shall take precedence. Grounding conductors are not necessarily indicated. See grounding requirements specified elsewhere herein.

160112. CIRCUIT IDENTIFICATION

The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C. Phase A shall be red, Phase B shall be black, and Phase C shall be blue. The neutral shall be white.

In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seaton, or equal. Identification shall match existing wire marker idents, or, if none exist, shall consist of circuit number or tag number.

Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seaton, or equal.

Exposed medium voltage conduits shall be labeled at 50-foot intervals with 1-inch letters stating the voltage - example - "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seaton, or equal.

160113 NAMEPLATES

Where indicated on the Plans, the Contractor shall furnish and install nameplates which shall be black lamicooid with white letters. The nameplates shall be fastened to the various devices with round head brass screws. Each disconnect means for service, feeder, branch, or equipment conductors shall have nameplates indicating its purpose.

160115 HIGH VOLTAGE WARNING SIGNS

Permanent and conspicuous warning signs shall be mounted on all equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.

Signs shall be in accordance with OSHA regulation, and shall be suitable for exterior use. The warning signals shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.

Signs shall be 7 inches high by 10 inches wide, colored red and white, on not less than 18 gauge vitreous enameling stock. Sign shall read:

WARNING
HIGH VOLTAGE
KEEP OUT

160116 CONDUCTOR FASTENERS

Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

160200 GENERAL MATERIALS AND METHODS

160201 GENERAL

All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Plans shall be new and unused, of current manufacture, and of highest grade consistent to the state of the art. Damaged materials, equipment and parts are not considered to be new and unused and will not be accepted.

Field verification of scale dimensions on Plans is directed since actual locations, distances, and levels will be governed by actual field conditions. The Contractor shall also review architectural, structural, yard, mechanical and other Plans, and the accepted electrical and mechanical shop drawings, and shall adjust his work to conform to all conditions indicated thereon.

The fabricator of major components, such as distribution panelboards, switchgear, motor control centers, shall also be the manufacturer of the major devices therein.

160202 RACEWAYS

Raceways include rigid metal conduit, rigid nonmetallic conduit, or any other channel for holding wires, cables, or bus bars that is designed for, and used solely for, this purpose.

160202.10 CONDUIT

160202.11 GENERAL

All conduit shall be rigid steel unless specifically indicated otherwise on the Plans. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than one inch.

Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the Engineer.

Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made, except in special pull boxes indicated on the Plans.

Conduits entering or exiting concrete shall be PVC coated or equivalent.

Conduit runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends or with fittings of the conduit type. Conduit type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers.

Conduit runs in buildings and structures shall be exposed except as specifically noted or accepted by the Engineer.

Conduit runs shall not interfere with the proper and safe operation of equipment and shall not block or interfere with ingress or egress, including equipment removal hatches.

Exposed conduits shall be securely fastened with regulation clamps or straps. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit and motors or control equipment. The maximum length of flexible conduit shall be 5 feet. Where flexible conduit is used, it shall be grounding type, weatherproof and watertight as manufactured by American Brass Company, General Electric, or equal. All condulets located outdoors or in wet locations shall be weathertight.

Conduit runs on water-bearing walls shall be supported one inch away from the wall on an accepted channel. When channel galvanizing or other coating is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.

Underground conduit runs shall be concrete encased, as detailed on the Plans, unless otherwise noted.

All conduit shall be thoroughly reamed after the threads have been cut to remove burrs. All joints shall be made with acceptable sealing compound and shall be watertight. Bushings or conduit fittings shall be used at all conduit terminals. The total of all bends in any run between pull boxes or junction boxes shall not exceed 360 degrees. Pull boxes shall be installed at points acceptable to the Engineer. Conduits brought into pull boxes, condulets, and other openings shall be capped until used to prevent the entrance of moisture. All spare conduits shall be capped and shall contain a suitable plastic pulling tape.

Joints shall be set up tight. Hangers and fastenings shall be secure and of a type appropriate in design and dimensions for the particular application.

After installation of complete conduit runs 2 inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be incorporated as part of the contract.

Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects or obstructions remain in the conduit prior to pulling in conductors.

Couplings, connectors, and fittings shall be threaded and shall be certified types specifically designed and manufactured for the purpose. They shall be installed expertly to provide a firm mechanical assembly and electrical conductivity throughout.

Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction. Expansion fittings shall be OZ type AX with jumper for exposed locations and type DX at structural expansion joints, Spring City, or equal.

Shop drawings shall be submitted as requested by the Engineer for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit.

160202.12 RIGID STEEL

Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate as manufactured by Triangle PWC, Inc., Allied Tube & Conduit Corporation, or equal.

Steel conduit shall not be buried in earth without concrete encasement except in special cases where PVC coating is indicated on the Plans.

160202.16 RIGID NONMETALLIC - PVC

Where specifically indicated on the Plans, or elsewhere specified, conduit may be high density Schedule 40, 90 degrees C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested. Encasement shall be reinforced as indicated on the Plans. Conduit supports shall be installed at 2-1/2 foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

160202.30 METAL PULL BOXES

160202.31. GENERAL

Furnish and install pull boxes as indicated on the Plans and specified herein. Unless specified otherwise, pull boxes shall be NEMA 4 rated.

Installation of pull boxes shall be such that access to the pull boxes is not restricted by obstructions such as pipes, valves, ladders, etc. Exact locations and sizes shall be submitted to the Engineer for review and acceptance prior to fabrication and installation.

Additional pull boxes shall be installed as required to meet cable manufacturer's pulling tension requirements.

Covers shall be secured with 316 stainless steel screws or bolts with coated threads.

160202.32 CONSTRUCTION

Pull boxes shall be compatible with the type of conduit systems on which they are used. Pull boxes shall be fabricated from 11-gauge (minimum) steel or aluminum and shall be completely weatherproof with gasketed removable covers. Weatherproof conduit hubs shall be furnished for all conduit connections to pull boxes.

160202.33. FINISH

All metal surfaces shall be phosphatized and primed with a rust-resistant paint. Finish shall be two coats of enamel paint.

160202.35 SIZING

Pull boxes shall be sized according to code and shall be sized to provide room for the future conduits and cables indicated on the Plans.

160203 CONDUCTORS

160203.01 GENERAL

All wiring shall be as indicated on the Plans. Wires shall be newly manufactured (not more than 12 months old) and shall be soft drawn copper with not less than 97 percent conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals. All wires shall conform to the latest Standards of the ASTM and ICEA and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

Wire sizes shall be American Wire Gauge sizes with Class B stranded construction. No. 12 and No. 10 AWG may be solid conductor.

No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

As far as practicable, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit.

160203.02 PULLING LUBRICANT

All cables shall be properly coated with pulling compound recommended by the cable manufacturer before being pulled into conduits so as to prevent mechanical damage to the cables during installation.

Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

160203.11. 5 KV CLASS CABLE

The cables shall be single-conductor, ethylene propylene shielded, poly-vinyl chloride jacketed, rated for 5 KV ungrounded neutral service with 90-degree C temperature rise. The cables shall meet all requirements of the ICEA and NEMA. The copper shall be concentric or compact round Class B stranded (7 strand for No. 2, all other 19 strand). The insulation thickness shall be at least 0.115-inch. The cables shall be as manufactured by Okonite Company, CABLEC Cable Company, or equal.

These cables shall be spliced only as required to meet manufacturers pulling tension requirements. All terminations shall be made in stress cones. The stress relief cones shall be carefully made up in accordance with the cable manufacturer's instructions. The cable terminations and splices shall be made by capable rated high voltage cablemen.

After the cables have been installed, the completed installation shall be tested per ICEA/NEMA, including voltage tests, prior to energizing the circuits. No equipment shall be connected to the cables during tests. Any faulty termination or cables detected shall be repaired or replaced by the Contractor and then retested at the Contractor's expense prior to acceptance.

The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded. Pull boxes located as indicated on the Plans are based on nominal pulling tension and side-wall pressures. Additional pull boxes shall be installed, as required, to meet the cable manufacturer's recommendations.

160203.12 TERMINATIONS AND SPLICES (MEDIUM VOLTAGE)

Terminations and splices shall be stress cones type single conductor style as manufactured by Bishop Electric, Elastimold, or equal.

160203.20 600 VOLT CLASS CABLE

Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have Type THWN insulation. Cable tray conductors shall have Type TC insulation. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Plans. Panel control wiring shall not be less than No. 14 AWG. Wire and cable shall be as manufactured by Okonite Company, Anaconda Wire and Cable Company, or equal.

The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded.

160203.21 TERMINATIONS AND SPLICES (600 VOLT AND LESS)

Terminations shall be terminal board type with set-screw pressure connectors. Splicing shall join conductors mechanically and electrically to

provide a complete circuit prior to installation of insulation. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be waterproof heat shrink type as manufactured by Elastimold, Thomas-Betts, or equal.

160203.35 COMMUNICATION CABLE

Communication (telephone, paging, intercom) cable shall have the number of twisted pairs indicated on the Plans. Unless otherwise indicated, conductor size shall be No. 22 AWG minimum and rated for 300 V minimum.

The jacket shall be of high molecular weight polyethylene surface printed with the year of manufacture and cable description at 2-foot intervals. The shield shall be 8 mil aluminum or copper overlapped to provide 100 percent cover. A copolymer or equal coating shall be applied to both sides to provide an effective moisture barrier. An inner jacket shall also be provided which shall be of high molecular weight polyethylene to provide strength and surge barrier.

Conductors shall be solid soft bare copper with thermoplastic insulation color coded per telephone industry standards. The insulated conductors shall be twisted into pairs with varying lengths of lay. A nonhygroscopic core tape shall be applied over the cable core as a dielectric and heat barrier.

Communication cable shall be as manufactured by General Electric, Okonite, or equal.

160204 GROUNDING

The grounding systems shall consist of concrete encased ground conductors and/or ground rods. Each duct bank shall contain a concrete encased system ground conductor. The system ground conductors shall run continuously in duct banks, through manholes, handholes, and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous ground system. Each metallic raceway, panel, switchboard, and other metallic devices associated with the electrical and instrumentation systems shall be bonded to this grounding system.

All equipment cases, devices, etc. shall be grounded. Ground rods shall be driven or concrete encased conductors installed before a building or structure is built and ground conductors brought through the concrete to accessible points for grounding equipment. These systems shall be installed at each structure where switchgear, motor control centers, switchboards, panelboards, etc. are installed.

Where ground conductors are not sized, the NEC shall govern. Driven ground rods shall be copperweld, or equal, 5/8-inch in diameter and not less than 10 feet in length.

All connections of ground cable to rods or to cable shall be thermoweld connections. Maximum allowable ground resistance shall be 5 ohms.

Tests shall be conducted by the Contractor and witnessed by the Engineer to determine the ground resistance for the entire system and at each building where there is switchgear, motor control, etc.

It is the intent of these Contract Documents that a grounding conductor for all device and equipment grounds shall be run as a separate conductor in the conduit from the equipment to the motor control center or system ground. All wireways, enclosures, etc. shall be properly bonded and grounded, and grounding conductors shall be run for all circuits.

160205 OUTLET, SWITCH, PULL AND JUNCTION BOXES

160205.01 GENERAL

Unless otherwise specified or indicated on the Plans, device boxes, condulets and junction boxes shall be heavy-duty cast and shall be compatible with the location and conduit system being used, rigid steel or rigid copper free aluminum and shall be as manufactured by Crouse-Hinds, Appleton, or equal, with stainless steel cover screws and with cover gaskets. Device boxes shall be FD type.

160205.10 FASTENERS

Fasteners used with wiring devices shall be aluminum or stainless steel and all screws, nuts, bolts, etc. shall be stainless steel.

160205.20. CONCRETE PULL BOXES

The Contractor shall furnish and install precast concrete pull boxes in the locations indicated on the Plans and as required.

The pull boxes shall be installed on 12 inches of compacted gravel and shall be installed in such a manner that the cover of the pull box will be flush with finished grade.

The pull boxes shall be designed for traffic conditions, and the pull box and cover shall be designed for heavy traffic bridge loading. The pull boxes shall be a minimum of 3' x 4' x 4' deep with 3/4 inch diameter pulling irons located at each end. The pull boxes shall be constructed of reinforced Class A concrete.

The pull boxes shall be Quickset, Utility Vault Co., or equal, with covers. The covers shall be engraved "ELECTRICAL".

160212 ENCLOSURES

160212.01 GENERAL

This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 4 for outdoor installations.

160212.10 CONSTRUCTION - STEEL

Enclosures shall be from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. They shall be as manufactured by Hoffman, Fischer & Porter, or equal.

A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.

160212.11 FINISH - STEEL

Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

160218 TERMINAL BLOCKS

Terminal blocks shall be Square D Co., Buchanan, or equal. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.

161100 CIRCUIT BREAKERS - LOW VOLTAGE

161100.01 GENERAL

All circuit breaker frame and trip ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished and shall be modified where necessary to suit this equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. Where no indication of type is given on the Plans, the following shall govern:

Circuit breakers protecting motors rated 7.5 horsepower or less shall be motor circuit protectors, all other circuit breakers shall be molded case circuit breakers.

Circuit breakers shall be as manufactured by Westinghouse, General Electric, or equal.

163100 LIGHTING

163110. GENERAL

Lighting fixtures shall be as described below and as indicated on the Plans.

Fixtures shall include lamps, ballasts, poles, mounting hardware, etc. to provide complete operating units.

Lamps shall be as manufactured by Westinghouse, Sylvania, or equal. High pressure sodium lamps shall be color corrected.

Fluorescent fixtures shall be rapid start type.

Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

Fixtures shall be as designated on the Plans.

163120 INSTALLATION

Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each fixture, or row of fixtures, shall be electrically connected by a length of Type SO flexible cord, 3 conductor No. 14 AWG, minimum, with a twist-lock plug to a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.

Pole mounted fixtures shall be mounted on steel or aluminum poles as designated in the fixture schedule or Plans. All metal poles shall be bonded to the plant ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated. All anchor bolts and nuts shall be stainless steel. Contractor shall paint all steel poles with aluminum paint or other color in accordance with these Contract Documents.

163130 BALLASTS

Ballasts shall be ETL/CBM certified for the purpose intended with built-in thermal protector that disconnects the ballast permanently prior to actual ballast failure. Where required by code, ballasts shall be two winding.

Ballasts shall be high efficiency, high power factor, constant wattage type and shall be fused.

Ballasts shall be Advance, Universal, or equal.

169000. PAYMENT

Payment for work under this section will be made at the lump sum bid for Item 1600-1, Electrical.

CONSTRUCTION SPECIAL PROVISIONS
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
SQUAW PEAK WATER TREATMENT PLANT
RELOCATIONS AT THE ARIZONA CANAL DIVERSION CHANNEL

TYPICAL DETAILS

INDEX

<u>Typical No.</u>	<u>Title</u>	<u>Page</u>
1	Structural Notes	SD-1
20	Construction Joint	SD-3
22	Expansion Joint	SD-4
149	Galvanized Steel Handrail	SD-5
152	Handrail Notes	SD-6
156	Kickplate	SD-7
220	Acceptable Joints on RCP	SD-8
230	Typical Pipe Thrust Blocking	SD-9
251	Encasement Section - Buried Fabricated Steel Pipe	SD-10
406	Steel Pipe Flexible Coupling Tie Down	SD-11
424	Sleeve Installation Through Dry Walls & Floor Slabs	SD-12
485	Air - Vacuum & Air Release Valve Assembly (AVAR)	SD-13
532	Cantilever Support Detail	SD-14
800	Encased Electrical Conduits	SD-15
801	Encased Electrical Conduits	SD-16
802	Encased Electrical Conduits at Manhole or Structures	SD-17
831	Area Lighting Fixture Mounting	SD-18

GENERAL:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK AND SHALL IMMEDIATELY NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
2. UNLESS DETAILED, SPECIFIED, OR INDICATED OTHERWISE, CONSTRUCTION SHALL BE AS INDICATED IN THE APPLICABLE TYPICAL DETAILS AND GENERAL NOTES. TYPICAL DETAILS ARE MEANT TO APPLY EVEN THOUGH NOT REFERENCED AT SPECIFIC LOCATIONS ON DRAWINGS.
3. WHERE NO CONSTRUCTION DETAILS ARE SHOWN OR NOTED FOR ANY PART OF WORK, DETAILS SHALL BE THE SAME AS FOR OTHER SIMILAR WORK.

REINFORCED CONCRETE:

1. ALL CONCRETE CONSTRUCTION, INCLUDING BENDING OF BARS, SHALL COMPLY WITH ACI "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" (ACI 318).
2. UNLESS CALLED OUT OTHERWISE ON THE PLANS, MINIMUM REINFORCEMENT OF CONCRETE WALLS OR SLABS SHALL BE:

8" THICK OR LESS	-	USE #5 @ 12" EW
9" OR THICKER	-	USE #5 @ 12" EWEF
3. ALL WALL REINFORCEMENT AT CORNERS OR JUNCTIONS OF WALLS SHALL BE CONTINUOUS, LAPPED, OR TERMINATED IN A STANDARD 90 DEGREE HOOK. LAP SPLICES SHALL CONFORM WITH NOTE 5.
4. UNLESS SHOWN OTHERWISE ALL BARS SHALL BE DOWELED. DOWELS SHALL BE THE SAME SIZE AND SPACING AS THE REINFORCEMENT WHICH IS TO BE SPLICED TO THE DOWELS.
5. UNLESS CALLED OUT OTHERWISE ON THE PLANS, THE LENGTH OF LAP SPLICES SHALL BE CLASS "B" WHERE NO MORE THAN 1/2 THE BARS ARE LAP SPLICED WITHIN THE LENGTH TABULATED BELOW AND CLASS "C" WHERE MORE THAN 1/2 THE BARS ARE LAP SPLICED WITHIN THE LENGTH TABULATED BELOW. ALL SPLICE LENGTHS SHALL BE IN ACCORDANCE WITH APPLICABLE TABULATED VALUES. LENGTHS ARE SHOWN IN INCHES. FOR BARS SPACED 6 INCHES ON CENTER OR FARTHER APART WITH AT LEAST 3-INCHES CLEAR FROM FACE OF MEMBER TO EDGE OF BAR, MEASURED IN DIRECTION OF SPACING, THE SPLICE LENGTH MAY BE REDUCED BY 20 PERCENT.

THE SPLICE LENGTH TABLE IS BASED ON $F_y = 60,000$ PSI.

		#4	#5	#6	#7	#8	#9	#10	#11
TOP BARS*	(CLASS "B")	22	27	33	44	58	74	94	115
	(CLASS "C")	29	36	43	58	76	97	123	151
OTHER BARS	(CLASS "B")	16	20	23	32	42	53	67	82
	(CLASS "C")	20	26	31	41	54	69	88	108

*TOP BARS ARE ALL HORIZONTAL REINFORCEMENT SO PLACED THAT MORE THAN 12 INCHES OF FRESH CONCRETE IS CAST IN THE MEMBER BELOW THE BAR.



STRUCTURAL NOTES

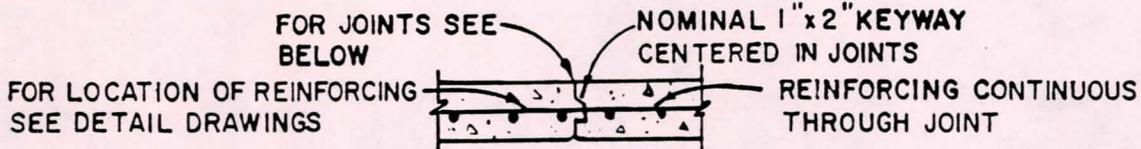
S 387

1 OF 2

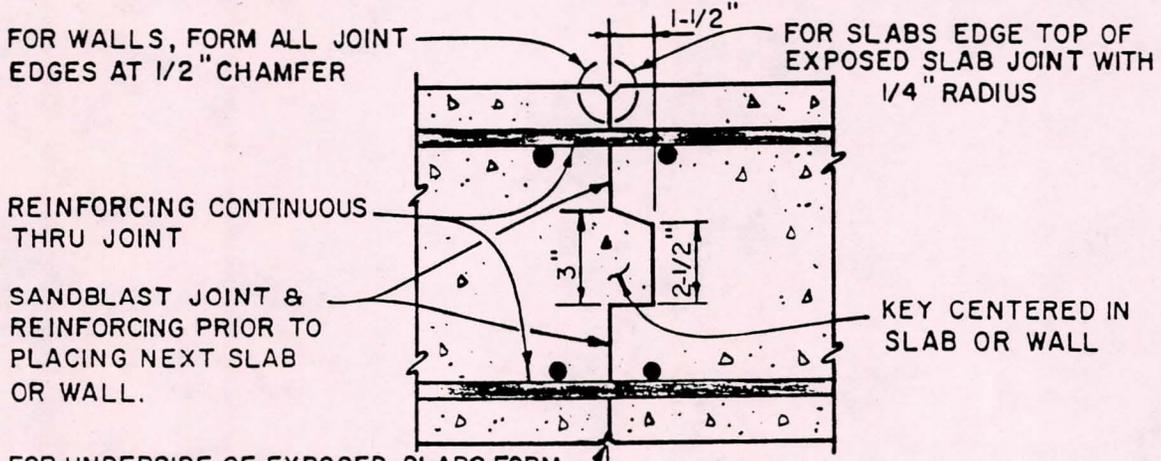
6. ALL SLABS, BEAMS AND COLUMN REINFORCING BARS SHALL HAVE A MINIMUM EXTENSION OR ANCHORAGE INTO SUPPORTS IN ACCORDANCE WITH ACI 318.
7. STIRRUP SUPPORT BARS SHALL BE PROVIDED BETWEEN ENDS OF TOP BARS AS REQUIRED.
8. UNLESS INDICATED OTHERWISE, CONCRETE COVER OVER REINFORCEMENT SHALL BE AS FOLLOWS:
 - A. SURFACES NOT EXPOSED DIRECTLY TO THE GROUND, WATER, OR WEATHER AFTER FORM REMOVAL:

CONCRETE SLABS IN BUILDINGS - - - - -	3/4"
CONCRETE SLABS OVER WATER BEARING STRUCTURES - - - - -	1"
CONCRETE BEAMS, GIRDERS, COLUMNS AND WALLS - - - - -	1-1/2"
 - B. SURFACES EXPOSED DIRECTLY TO THE GROUND, WATER OR WEATHER AFTER FORM REMOVAL:

FOR #5 BARS OR SMALLER - - - - -	1-1/2"
FOR #6 BARS OR LARGER - - - - -	2"
 - C. CONCRETE PLACED DIRECTLY AGAINST GROUND - - - - - 3"
 - D. REINFORCEMENT SHALL BE PLACED WITHIN A TOLERANCE OF $\pm 1/4"$ OF POSITION SPECIFIED.
9. KEYWAYS AND WATER STOP SHALL END 3" BELOW THE TOP OF WALLS, UNLESS THERE IS A SLAB ON TOP OF THE WALL, IN WHICH CASE IT SHALL END AT BOTTOM OF THE SLAB. IN JOINTS WHERE WATERSTOP TERMINATES AT ADJOINING SLAB OR WALL, WATER STOP SHALL BE EMBEDDED IN ADJOINING SLAB OR WALL A MINIMUM OF 6".
10. CONCRETE CURING SHALL BE IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. SOME CONCRETE WORK REQUIRES WATER CURING, AS MEMBRANE CURING IS NOT ALLOWED. THE CONTRACTOR IS WARNED THAT WATER CURING IS DIFFICULT AT TIMES DUE TO WIND AND DRY CONDITIONS. THE CONTRACTOR SHALL STUDY REQUIREMENTS AND SHALL FURNISH ADEQUATE SYSTEMS TO PROVIDE WATER CURING WHERE REQUIRED. TOP OF WALLS SHALL BE KEPT VISIBLY MOIST AT ALL TIMES AND SHALL BE FLOODED NOT LESS THAN THREE TIMES DAILY.
11. WATERSTOP SHALL BE PLACED IN ALL CONSTRUCTION, CONTRACTION, AND EXPANSION JOINTS IN ALL WATERBEARING SLABS AND WALLS UNLESS CALLED OUT OTHERWISE ON THE PLANS, AND ALL WALLS AND SLABS SUBJECTED TO GROUNDWATER. WATERSTOP IN THE WALLS SHALL BE CARRIED INTO SLABS AND SHALL BE SPLICED WITH THE WATER STOP IN THE SLABS.
12. NO BACKFILL SHALL BE PLACED AGAINST WALLS UNTIL CONCRETE HAS REACHED 85 PERCENT OF THE SPECIFIED STRENGTH AND THE CONNECTING SLABS AND BEAMS HAVE BEEN CAST AND HAVE REACHED 85 PERCENT OF THE SPECIFIED STRENGTH.

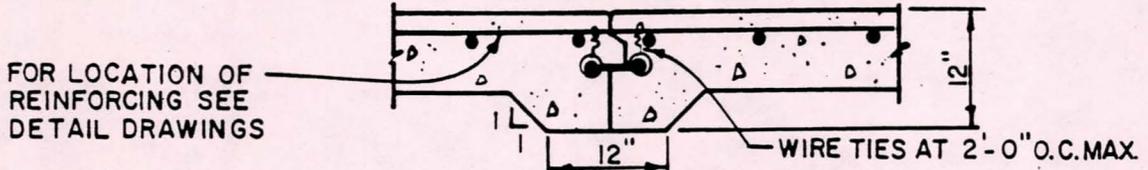


WALL OR SLAB WITH SINGLE CURTAIN REINFORCING

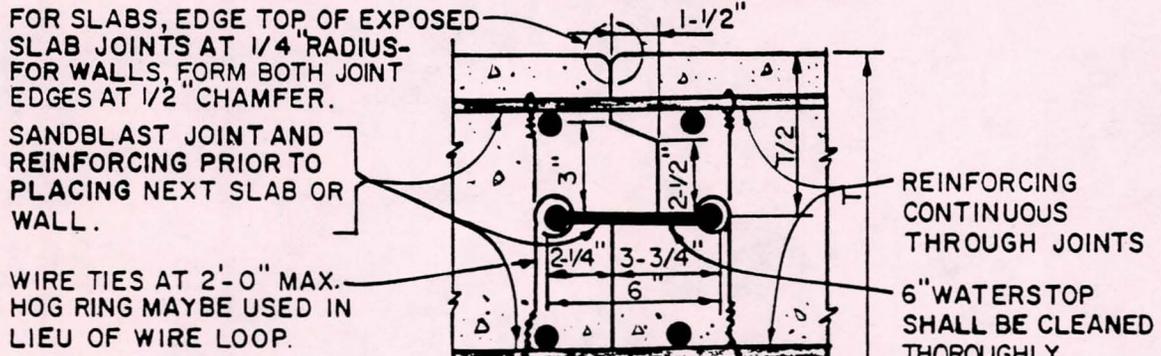


FOR UNDERSIDE OF EXPOSED SLABS FORM BOTH JOINT EDGES AT 1/2" CHAMFER

SLAB OR WALL (NON WATER BEARING)



SLAB THICKENING DETAIL (WATER BEARING LESS THAN 12" THICK)



NOTES:
 I. EMBED WATERSTOP FROM WALLS 6" INTO BASE SLAB AT POINTS WHERE THE WATERSTOP IS NOT REQUIRED TO CONTINUE THROUGH SLAB.

SLAB OR WALL (WATER BEARING)

CONSTRUCTION JOINT

20
 TYP S 482

CAULK WITH SYNTHETIC RUBBER ON EXPOSED SURFACES OF WALLS AND SLABS (TYP)

EXPANSION JOINT

FOR EXPOSED SLABS EDGE WITH 1/4" RADIUS (TYP)

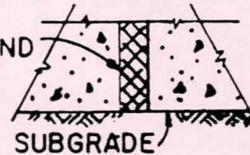
FOR WALLS FORM ALL FACES 1/2" CHAMFER

SYNTHETIC SPONGE RUBBER FILLER

SYNTHETIC SPONGE RUBBER EXPANSION JOINT MATERIAL (TYP)

FOR EXPOSED BOTTOM OF SLABS, FORM 1/2" CHAMFER

EXTEND TO GROUND WHEN SLAB ON GRADE.



NON-WATER BEARING SLAB OR WALL

A DETAIL
SLAB ON GRADE

FOR EXPOSED SLABS EDGE WITH 1/4" RADIUS (TYP)

FOR WALLS FORM ALL FACES 1/2" CHAMFER

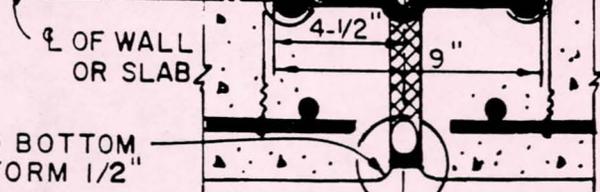
CAULK WITH SYNTHETIC RUBBER ON EXPOSED SURFACES OF WALLS AND SLABS.

SYNTHETIC SPONGE RUBBER FILLER (TYP)

SYNTHETIC SPONGE RUBBER EXPANSION JOINT MATERIAL (TYP)

WIRE TIES AT 2'-0" O C MAX

9" CENTER BULB WATERSTOP SHALL BE CLEANED THOROUGHLY BEFORE PLACING CONC. W=1" THICK UNLESS SHOWN OTHERWISE ON THE PLANS.



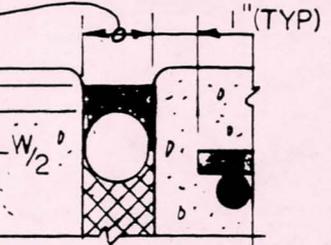
FOR EXPOSED BOTTOM OF SLABS, FORM 1/2" CHAMFER

NOTE:

- 1. SLABS ON GRADE SHALL BE THICKENED AT JOINT PER



WATER BEARING SLAB OR WALL

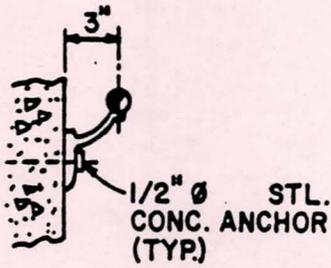


B DETAIL

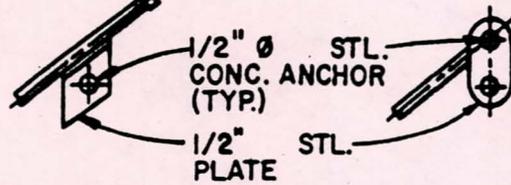
22
TYP

EXPANSION JOINT

S 387



END CLOSURE (TYP.)



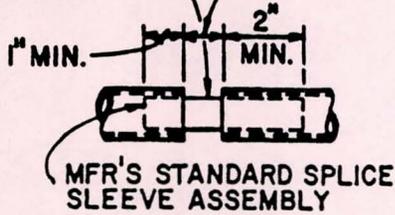
SIDE PLATE

END PLATE

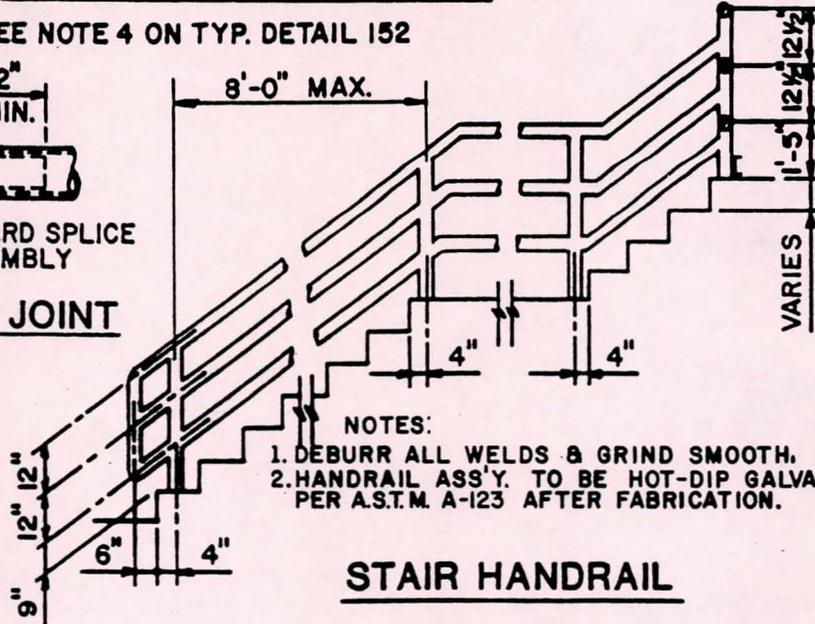
SINGLE RAIL BRACKETS

REAM PIPE FOR FREE FIT

SEE NOTE 4 ON TYP. DETAIL 152



RAIL SLIP JOINT

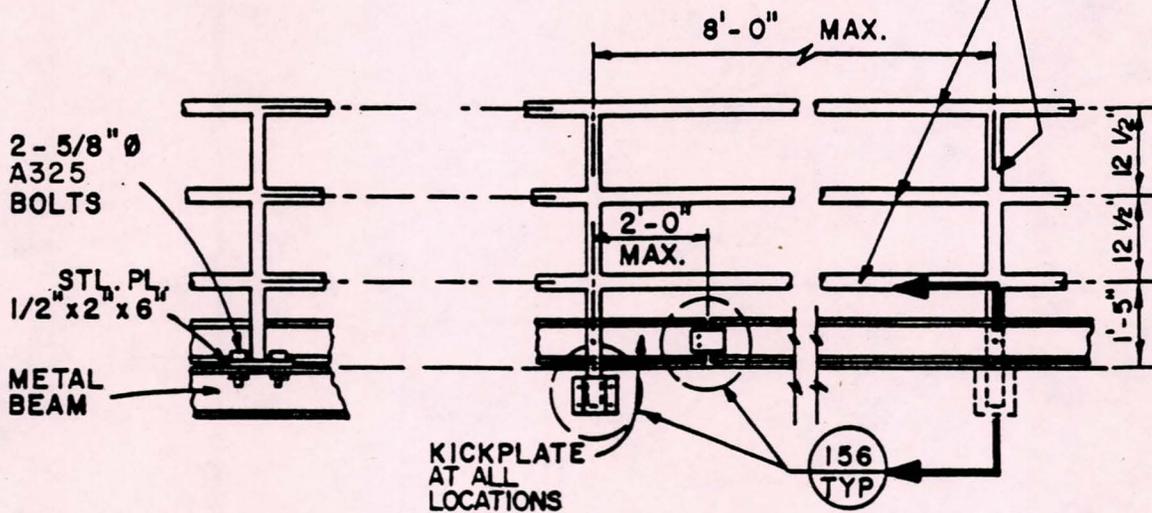


NOTES:

1. DEBURR ALL WELDS & GRIND SMOOTH.
2. HANDRAIL ASS'Y. TO BE HOT-DIP GALVANIZED PER A.S.T.M. A-123 AFTER FABRICATION.

STAIR HANDRAIL

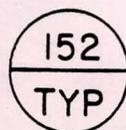
1/2 SCHEDULE 40 STL. PIPE RAILINGS & POSTS W/ STL. KICKPLATE & FITTINGS.



149 TYP

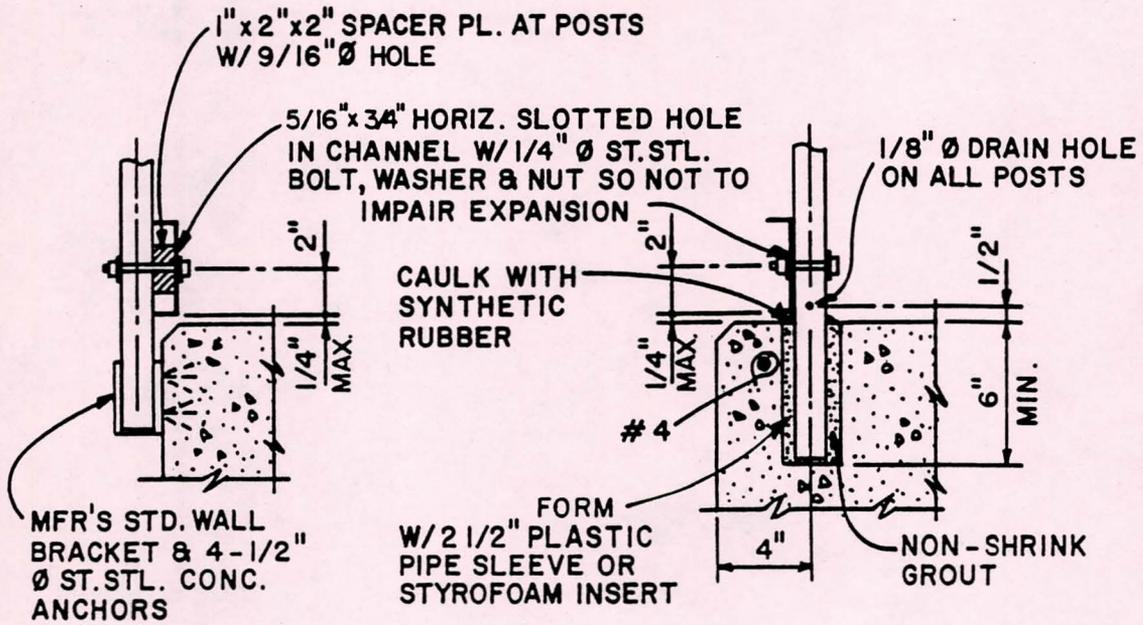
GALVANIZED STEEL HANDRAIL

1. PLACE CENTER OF HANDRAIL 4" FROM EDGE OF CONCRETE UNLESS OTHERWISE NOTED ON PLANS.
2. PLACE HANDRAIL POSTS OPPOSITE EACH OTHER WHERE HANDRAILS ARE PARALLEL.
3. COAT ALL SURFACES OF ALUM THAT COME IN CONTACT WITH CONCRETE IN ACCORDANCE WITH SPECIFICATIONS. PLACE NEOPRENE GASKET BETWEEN ALUM AND STEEL.
4. PROVIDE SLIP JOINT AT 24' MAX CENTERS FOR EXPANSION OF RAILS AND KICKPLATE. GAP AT TIME OF INSTALLATION SHALL BE BASED ON TEMPERATURE OF HANDRAIL (3/8" GAP AT T = 25°F, 0" GAP AT T = 100°F). AT CONCRETE EXP JTS PROVIDE 1" GAP IN SLIP JOINT. INSERT SLEEVES SHALL BE LONG ENOUGH TO ALLOW FOR THE FULL RANGE OF MOVEMENT.
5. KICKPLATE MAY BE EXTRUDED OR BENT PLATE AND SHALL BE ATTACHED WITH ST STL BOLTS IN 5/16" X 3/4" SLOTTED HOLES. BOLT KICKPLATE TO POST WITH BOTTOM 1/4" CLEAR (MAX) FROM SURFACE. FOR SIDE MOUNTED HANDRAIL, PROVIDE STANDARD SPACER BLOCK BETWEEN POST AND KICKPLATE TO MAINTAIN 1/4" MAXIMUM CLEAR SPACING. PROVIDE KICKPLATE AT ALL PLACES WHERE DROP FROM ONE LEVEL TO ANOTHER EXCEEDS 4'-0" AND WHERE SHOWN ON THE PLANS. HAND TIGHTEN AND CENTER PUNCH BOLT TO LOCK. SPLICES SHALL ACCOMMODATE TEMPERATURE EXPANSION PER NOTE 4.
6. STAIR RAILS ALONG WALLS SHALL BE FASTENED WITH STANDARD WALL BRACKET AT 5'-0" OC MAXIMUM. END OF RAILS SHALL HAVE CLOSURES. STAIR RAILS SHALL BE OFFSET TO PROVIDE 3" MIN CLEARANCE FROM ALL OBSTRUCTIONS.
7. ALL HANDRAILS SHALL BE FIXED UNLESS OTHERWISE NOTED.
8. HANDRAILS ALONG WALLS SHALL BE SINGLE RAIL AT 3'-6" HEIGHT, OR TO MATCH TOP RAIL ON OPPOSITE SIDE.
9. ALL JOINTS FOR STAINLESS STEEL HANDRAIL SHALL BE COPED, WELDED, AND GROUND SMOOTH.
10. FOR HANDRAIL MOUNTED TO BEAM OR STAIR CHANNEL, PROVIDE MANUFACTURER'S REINFORCED CONNECTION FROM PIPE RAIL TO PLATE. PLATE AND REINFORCED INSERTS SHALL BE ALUMINUM OR STAINLESS STEEL.
11. MATERIAL FOR SLIP JOINT PLATE AND KICKPLATE CHANNEL SHALL BE OF THE SAME MATERIAL AS THE HANDRAIL.



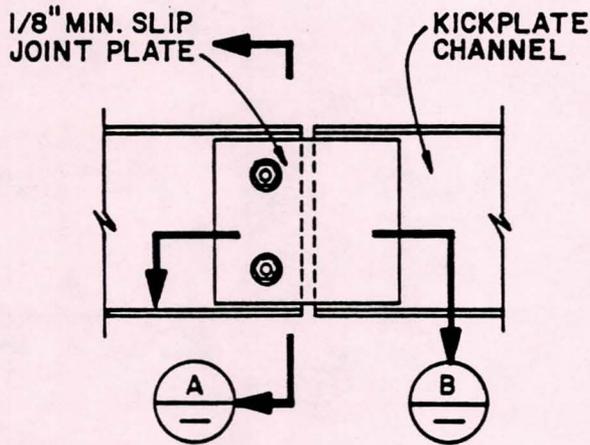
HANDRAIL NOTES

S 387

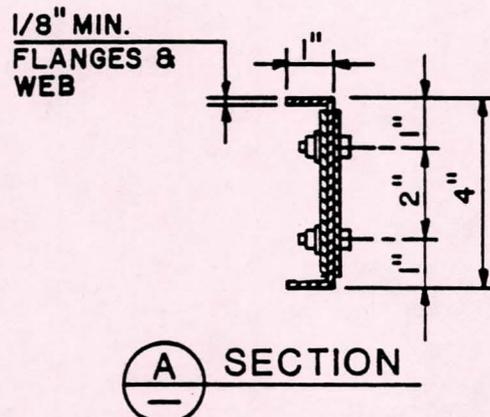


SIDE MOUNTED POST

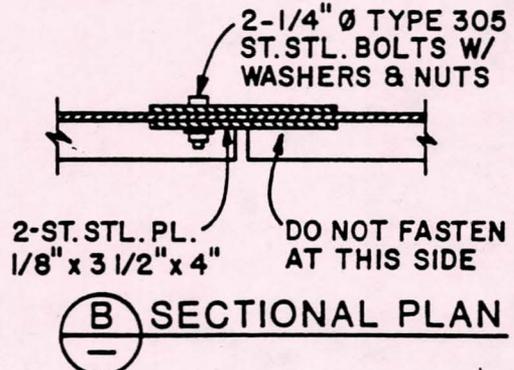
EMBEDDED POST



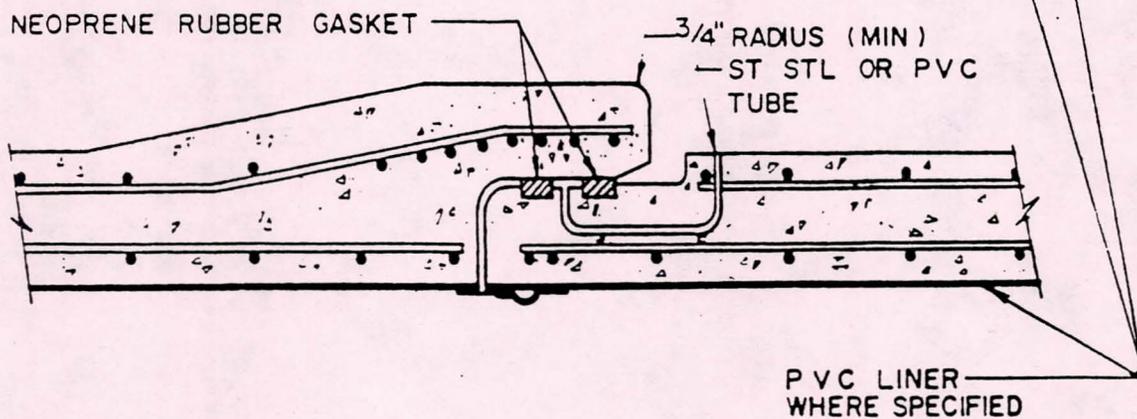
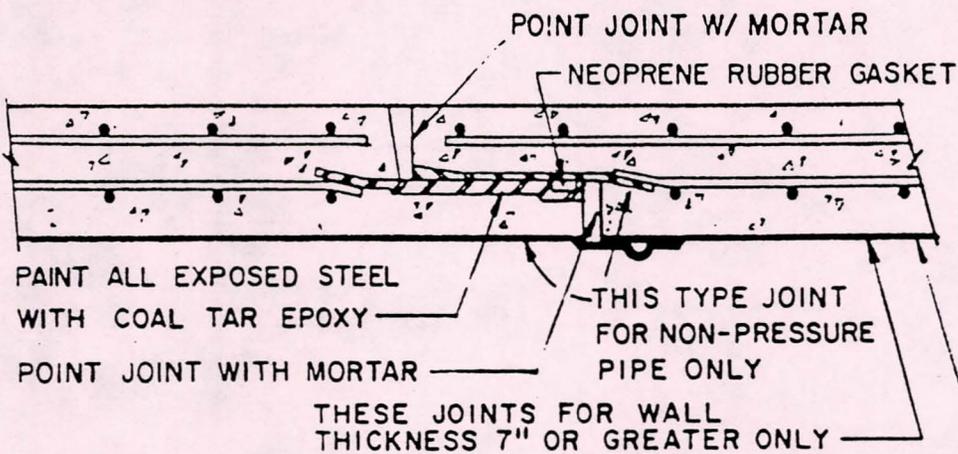
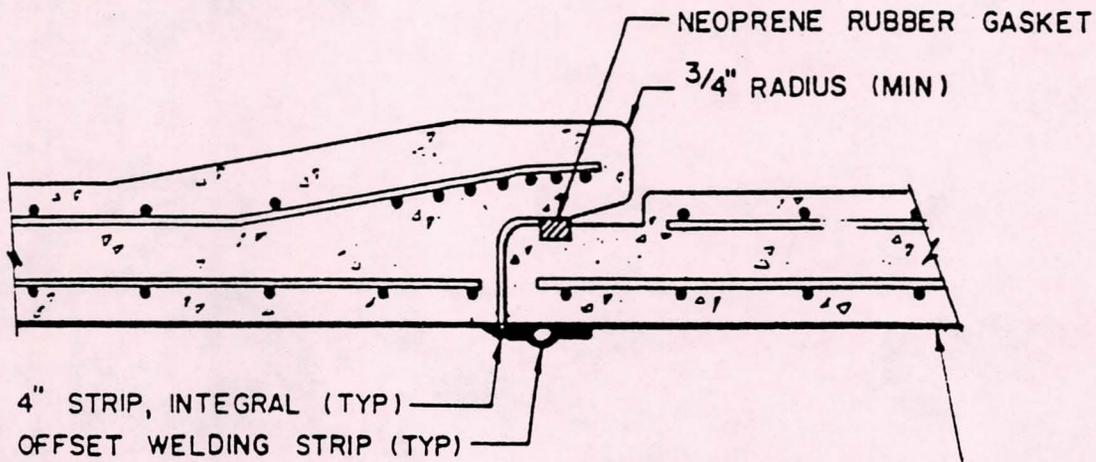
KICKPLATE JOINT



NOTE:
SEE TYP. DETAIL 152 FOR
HANDRAIL NOTES



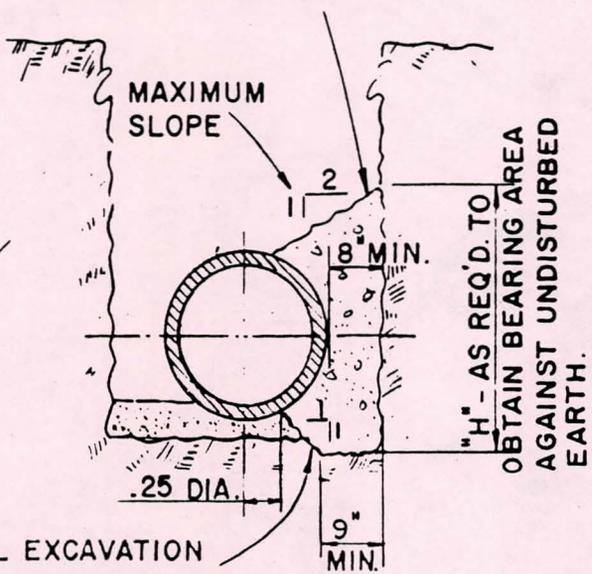
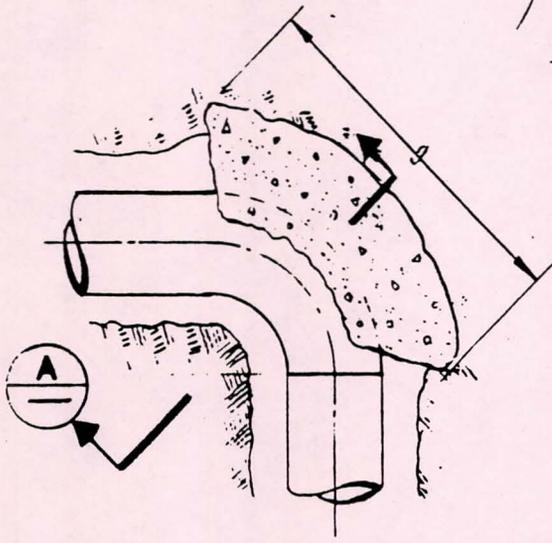
156 KICKPLATE
TYP S 385



220 ACCEPTABLE JOINTS ON R C P
 TYP S 387

LENGTH AS REQUIRED TO OBTAIN BEARING AREA AGAINST UNDISTURBED EARTH

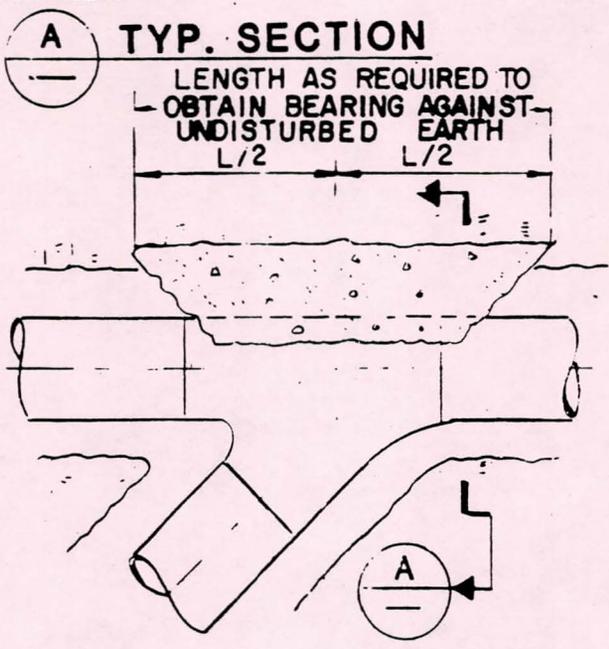
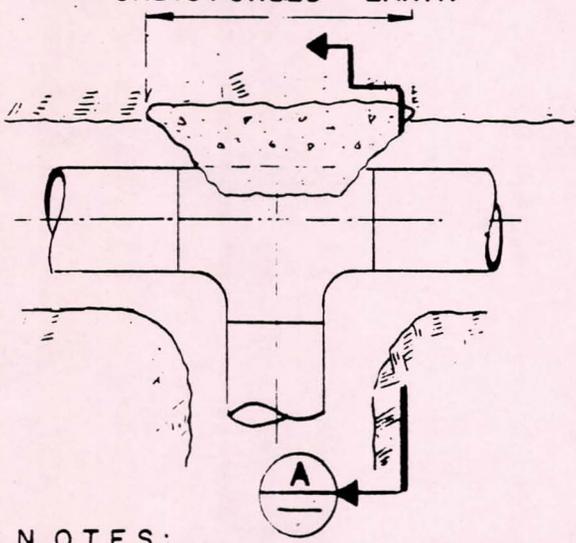
POUR LEVEL WITH TOP OF PIPE OR SLOPE UP IF NECESSARY TO OBTAIN REQUIRED BEARING AREA



ADDITIONAL EXCAVATION IF NECESSARY TO OBTAIN REQUIRED BEARING AREA

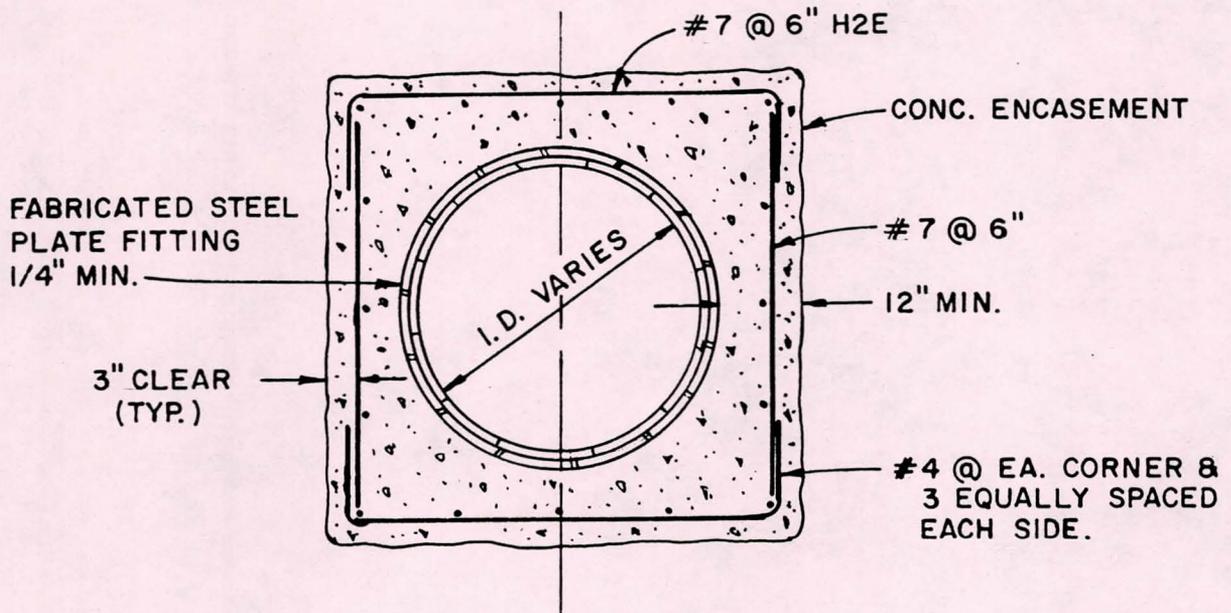
LENGTH AS REQUIRED TO OBTAIN BEARING AGAINST UNDISTURBED EARTH

A TYP. SECTION

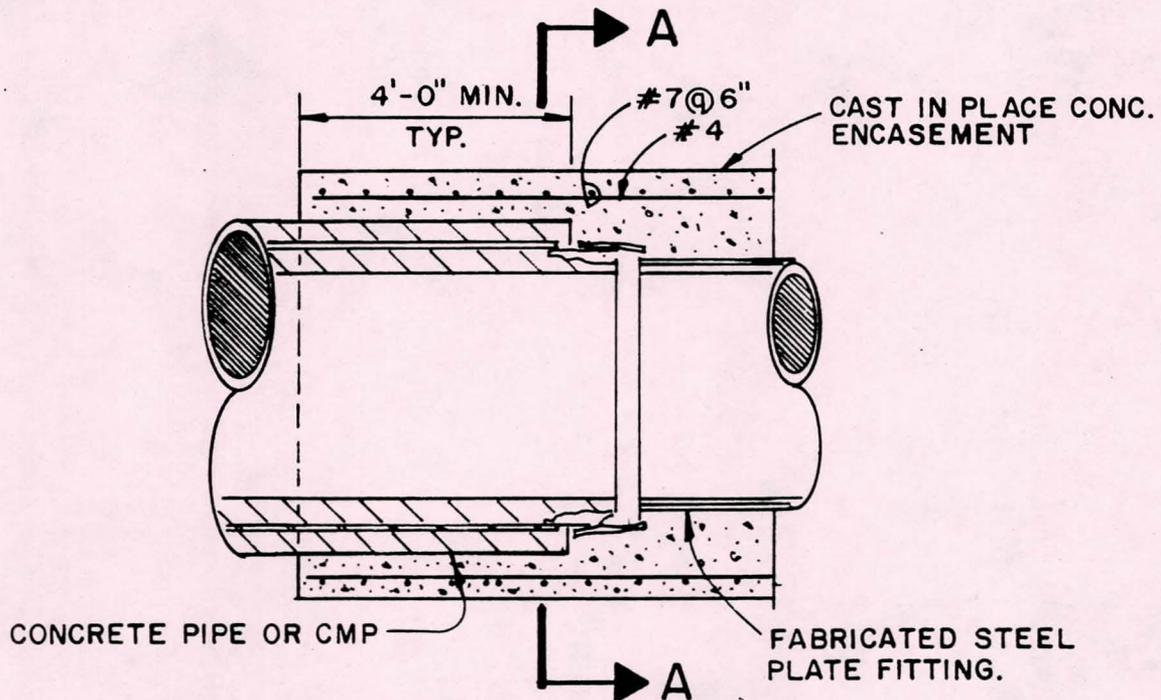


NOTES:

1. BEARING AREA IS THE AREA REQUIRED TO OBTAIN A MAXIMUM SOIL LOADING OF 200 PSF PER FOOT OF DEPTH TO A MAXIMUM VALUE OF 1500 PSF WHEN THE PIPE IS SUBJECTED TO IT'S TEST PRESSURE. OR BEARING AREA SHOWN ON PLANS. AREA MAY BE DECREASED IF SUBSTANTIATED BY SOIL BEARING TESTS.
2. CONCRETE SHALL BE MAG CLASS "C."



SECTION - A



NOTE: ENCASEMENT TO EXTEND MIN. 6" BEYOND PIPE EXIT FROM GROUND.

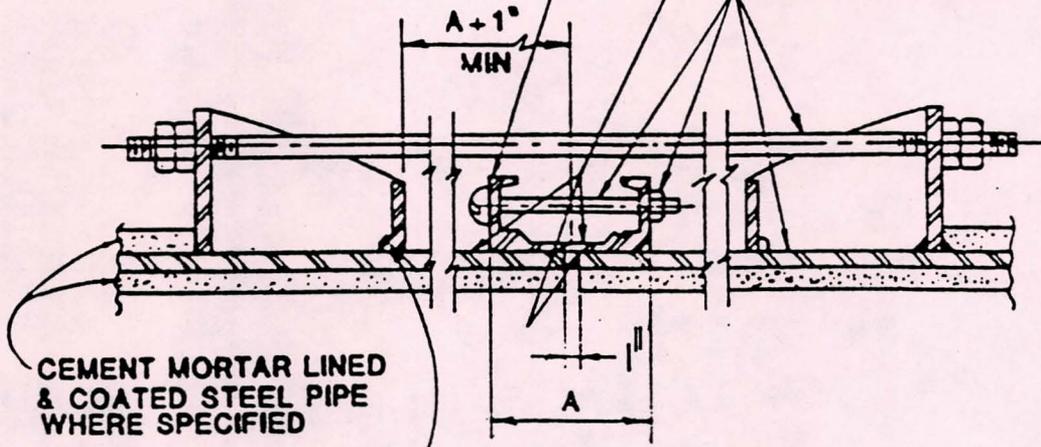
251
TYP.

**ENCASEMENT SECTION -
BURIED FABRICATED STEEL
PIPE**

FLEX COUPLING TO SUIT
PIPE CENTERED ON JOINT

COAT W/ EPOXY PER SPECS

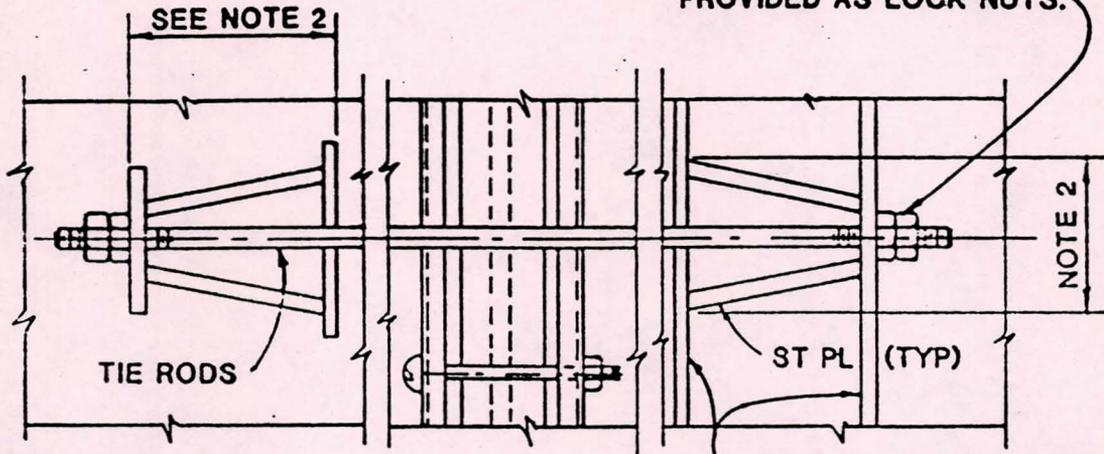
COAT PER SPECS



CEMENT MORTAR LINED
& COATED STEEL PIPE
WHERE SPECIFIED

PROVIDE 1/4" DRAINAGE
HOLE

FINGER TIGHTEN NUTS
AGAINST ANCHOR PLATES,
DOUBLE NUTS SHALL BE
PROVIDED AS LOCK NUTS.

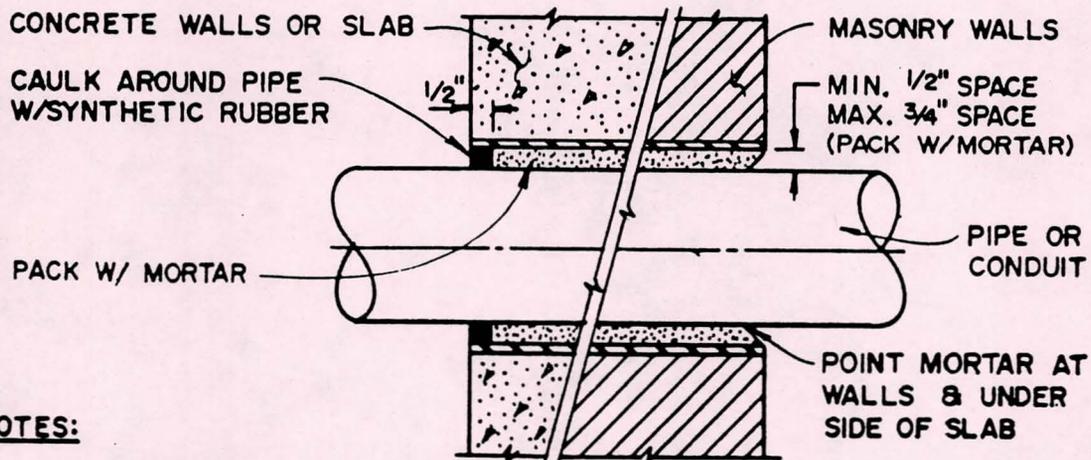


NOTES:

1. DESIGN SHALL BE BASED ON TEST PRESSURE
2. ANCHOR LUGS AND TIE RODS FOR STEEL PIPE SHALL BE DESIGNED BY PIPE MFR IN ACCORDANCE WITH AWWA STEEL PIPE MANUAL
3. GRIND ALL CORNERS

406
TYP

**STEEL PIPE FLEXIBLE
COUPLING TIE DOWN**



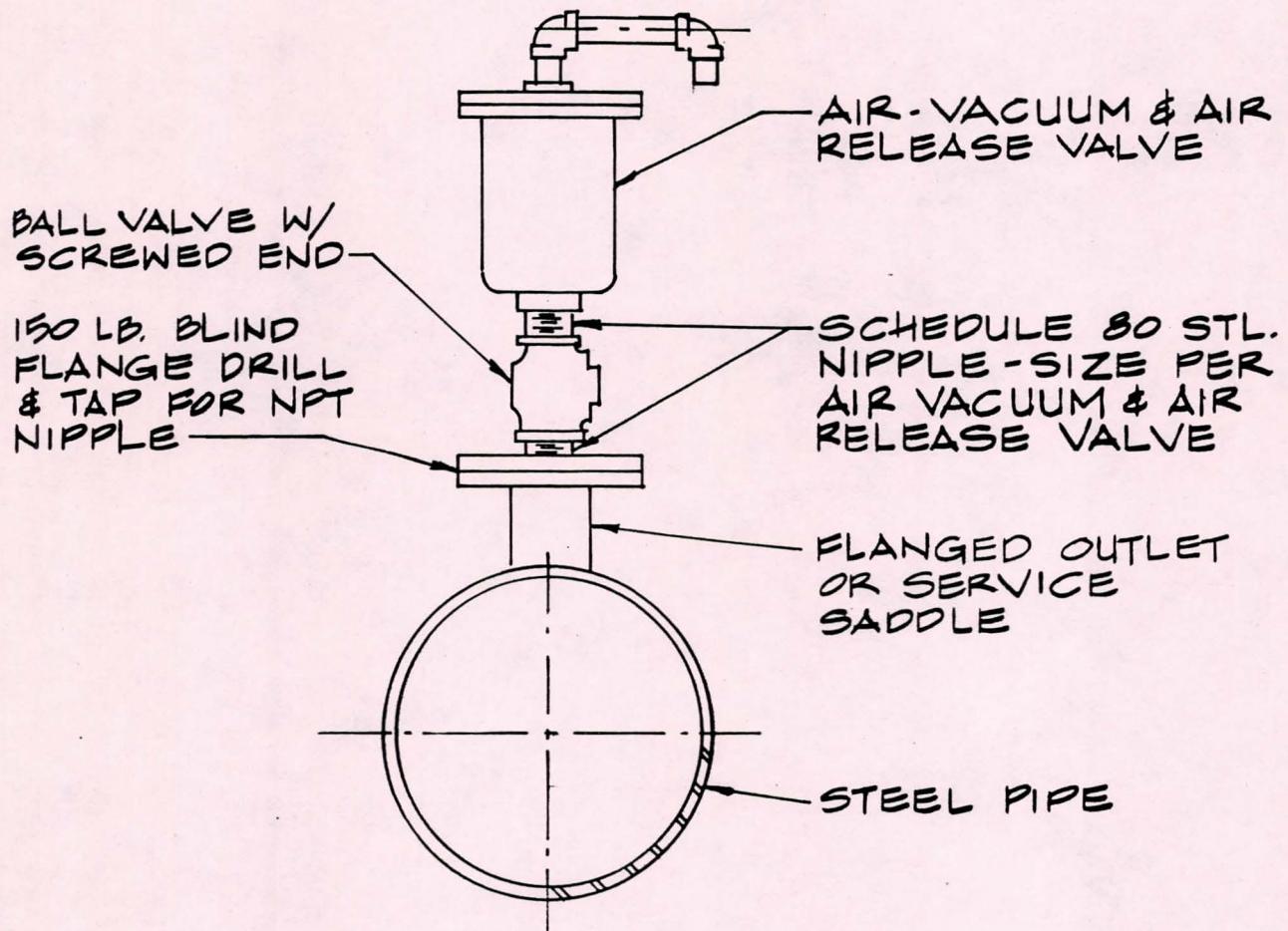
NOTES:

1. 6" ϕ SLEEVES AND SMALLER-SCH 40 STL PIPE OR SCH 80 PVCP.
2. 8" ϕ SLEEVES AND LARGER- $\frac{1}{4}$ " THICK STL PIPE.
3. STL. PIPE SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.
4. SLEEVE MAY BE OMITTED IF HOLE IS CORE DRILLED. CORE DRILLING IS SUBJECT TO ENGINEER'S APPROVAL.
5. SLEEVES FOR ELECTRICAL CONDUIT SHALL BE SCHED 80 PVCP.

424
TYP

s 385

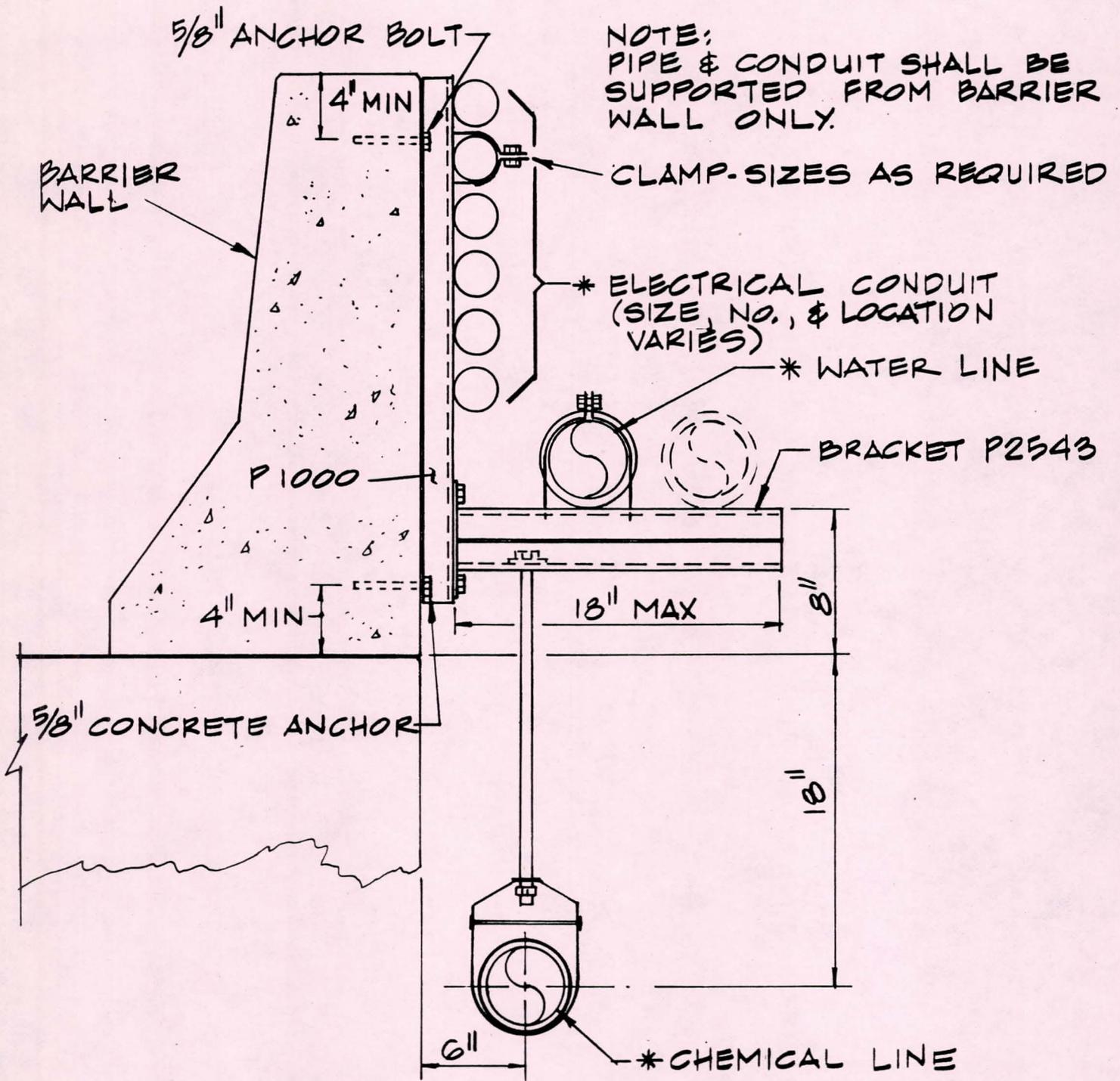
**SLEEVE INSTALLATION THROUGH
DRY WALLS & FLOOR SLABS**



SERVICE		VALVE SIZE
66"	WATER MAIN	10"
60"	WATER MAIN	10"
66"	RAW WATER	12"
48"	RAW WATER	6"

AVAR SCHEDULE

485 AIR-VACUUM & AIR RELEASE VALVE
 TYP ASSEMBLY (AVAR)



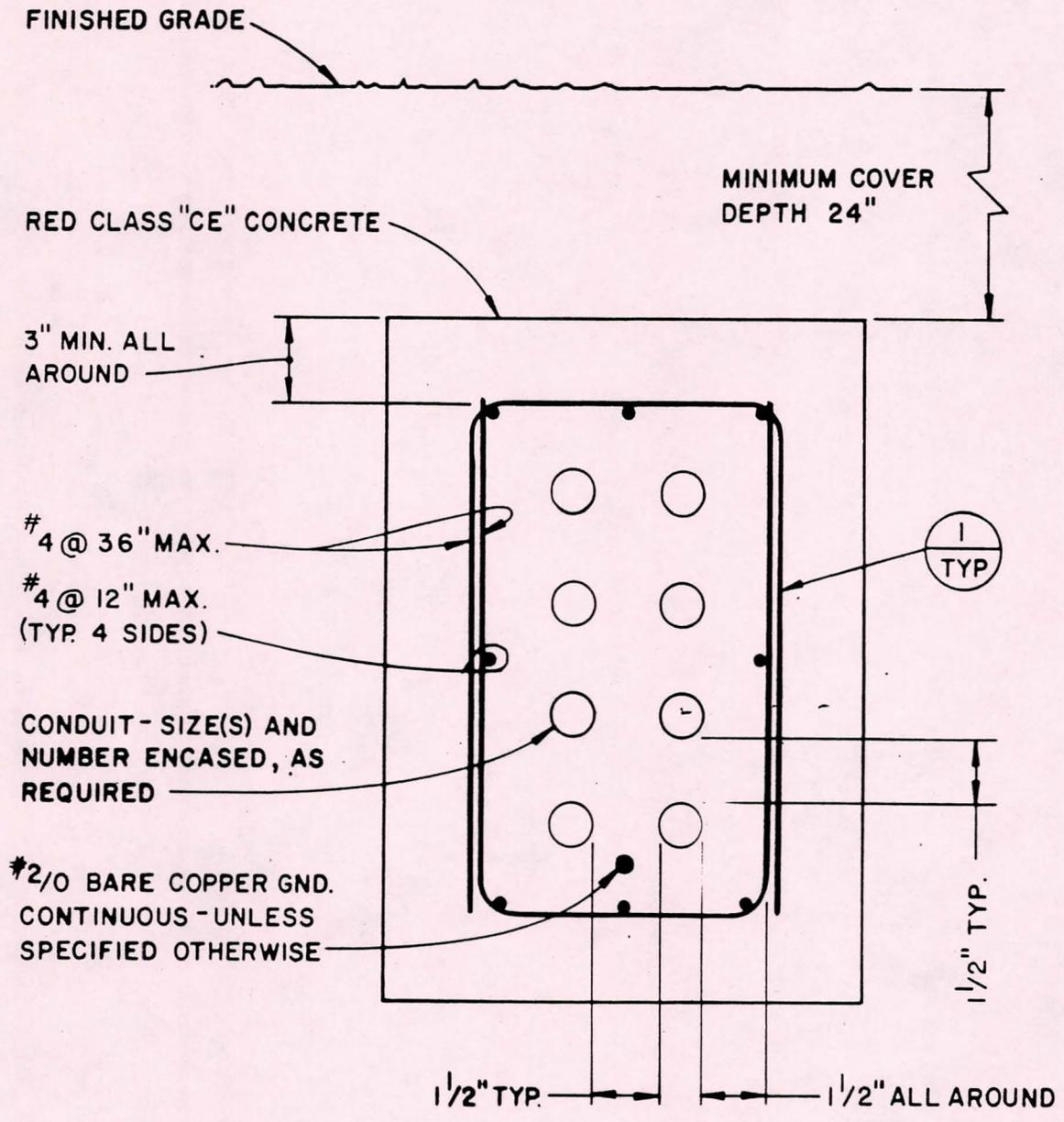
NOTES:

* WHERE SHOWN ON PLANS

1. MODEL NUMBERS BASED ON UNISTRUT OR EQUAL ALL FASTENERS SHALL BE STAINLESS STEEL.
2. MAX LOAD ON BRACKET 3 - 4" Ø PIPES.
3. MAX SUPPORT SPACING 5'-0" O.C.

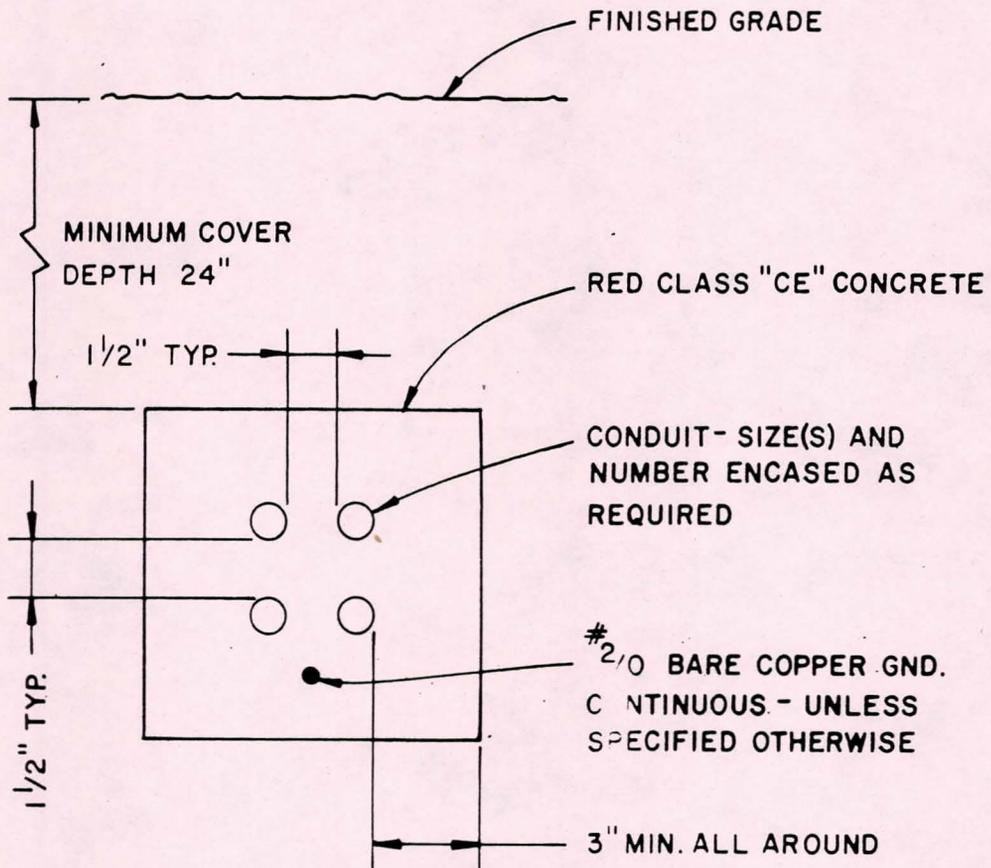
532
TYP

CANTILEVER SUPPORT DETAIL



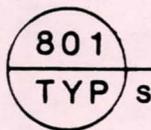
NOTE:
 1. ALL DIMENSIONS ARE MINIMUM, EXCEPT WHERE SHOWN OTHERWISE.

800
 TYP. s **ENCASED ELECTRICAL CONDUITS**

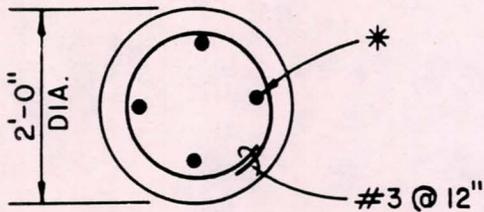


NOTE:

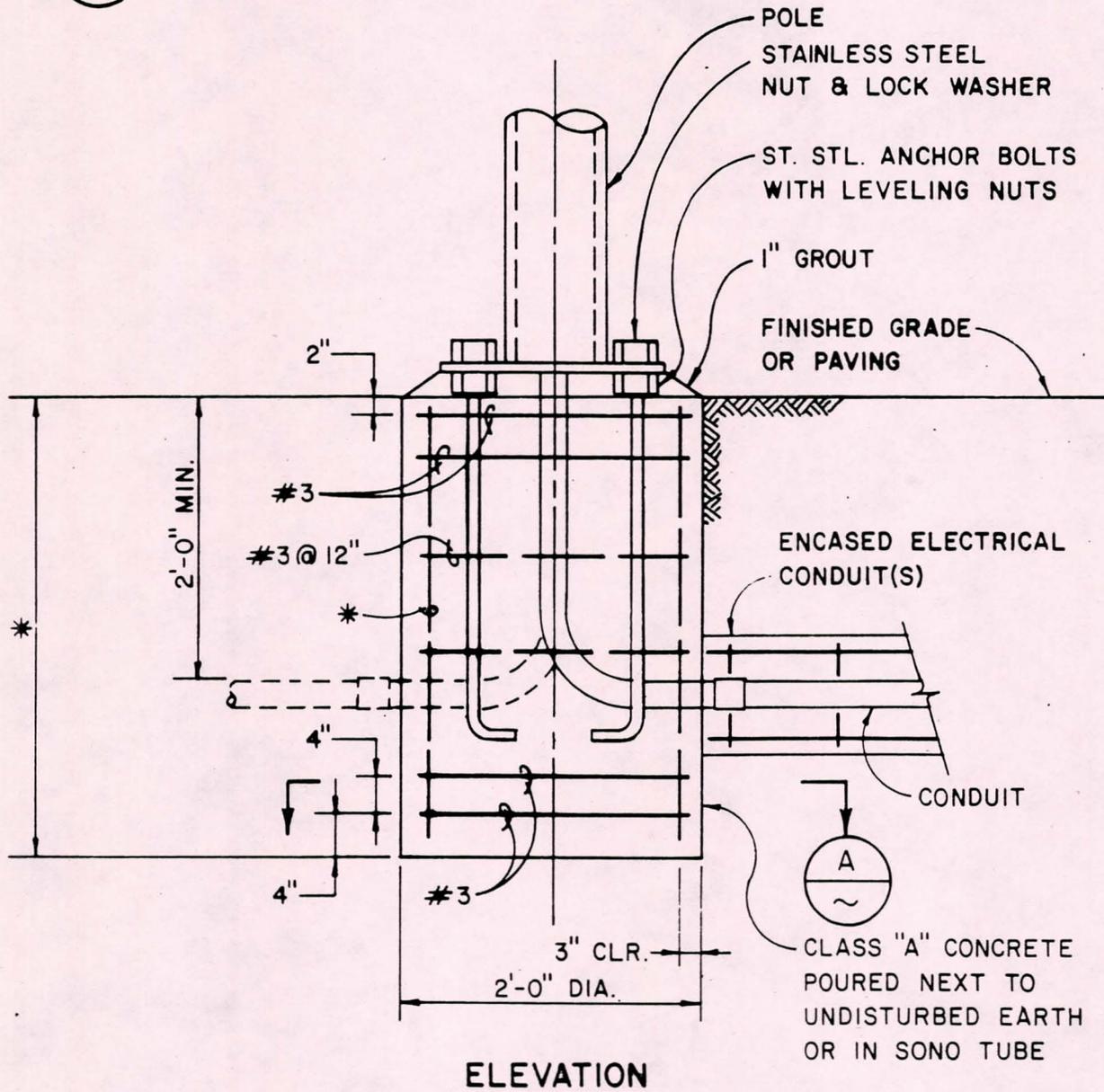
- I. ALL DIMENSIONS ARE MINIMUM, EXCEPT WHERE SHOWN OTHERWISE.



ENCASED ELECTRICAL CONDUITS



A SECTION



831
TYP. s

AREA LIGHTING FIXTURE MOUNTING