

CITY OF MESA

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2007 TRANSMISSION

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City Project No 85-18

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SPECIFICATIONS
AND
DOCUMENTS

CITY OF MESA
WATER WORKS IMPROVEMENTS
BROWN ROAD TRANSMISSION MAIN
CITY PROJECT NO. 85-18



BLACK & VEATCH ENGINEERS-ARCHITECTS
PHOENIX, ARIZONA

PROJECT 11785.PLD
1985

CITY OF MESA, ARIZONA
CITY PROJECT NO. 85-18
BROWN ROAD TRANSMISSION MAIN

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CITY OF MESA

MESA, ARIZONA

EAST BROWN ROAD TRANSMISSION WATER MAIN
C.A.P. PLANT TO CRISMON RESERVOIR

PROJECT NO. 85-18

ADVERTISEMENT FOR BIDS

NOTICE IS HEREBY GIVEN that sealed bids will be received until 2:00 P.M. on October 10, 1985 at the office of the City Engineer at 55 North Center Street, Mesa, Arizona, until the time and date indicated above for furnishing all labor, materials, transportations and services for the construction and/or installation of the following work:

A water transmission main including valves, manholes, air release and blowoff assemblies, contract customer metering station, connections with existing facilities, and other appurtenant work as indicated on the drawing and as specified. The transmission main consists of approximately 15,850 linear feet of 36 inch pipeline and approximately 2,725 linear feet of 30 inch pipeline and approximately 45 linear feet of 24 inch pipeline and 45 linear feet of 16 inch pipeline.

The water transmission main is located along Brown Road between the Mesa Water Treatment Plant and Crismon Road and along Crismon Road one-half mile North of the intersection of Brown and Crismon Roads.

For general information call William McCarthy-City of Mesa, at 834-2515.
Job specific information call Brad Hemken-Black&Veatch, at 957-2795.

Plans, Specifications, Contract Forms and Bid Proposal Forms may be obtained from the Engineering Permit Section, 55 North Center Street at \$ 40.00 (nonrefundable) per set.

Work shall be completed within 180 calendar days, beginning with the day following the starting date specified in the Notice to Proceed.

Bids must be submitted on the Proposal Form provided and be accompanied by a Bid Bond for not less than ten percent (10%) of the total bid, payable to the City of Mesa, Arizona, using the Surety Bond form provided.

The successful bidder will be required to execute the standard form of contract for construction within ten (10) days after formal award of contract.

The successful bidder, simultaneously with the execution of the Contract, will be required to furnish a Payment Bond in the amount equal to one hundred percent (100%) of the Contract Price, a Performance Bond in an amount equal to one hundred percent (100%) of the Contract Price, and a Certificate of Insurance.

(MESA, ARIZONA)
(11785.PLD)

AB-1

The right is hereby reserved to accept or reject any or all bids or parts thereto, to waive any informalities in any proposal and reject the bids of any persons who have been delinquent or unfaithful to any contract with the City of Mesa.

DEAN SLOAN
Public Works Manager

ATTEST:
Dorthe Dana
City Clerk

(MESA, ARIZONA)
(11785.PLD)

AB-2

CITY OF MESA
MESA, ARIZONA

EAST BROWN ROAD TRANSMISSION MAIN

PROJECT NO. 85-18

ADDENDUM NO. 1

See attached sheets.

The Contractor shall use the attached Bid Schedule when submitting a bid.

I acknowledge receipt of this revision and will use it for bidding purposes on the above project.


Contractor's Signature

10-24-85
Date

Note: A signed copy of this Addendum is to be returned with the Contractor's Proposal. The Contractor should also acknowledge this Addendum in the space provided on the Proposal.

DEAN SLOAN
Public Works Director

CITY OF MESA
MESA, ARIZONA

EAST BROWN ROAD TRANSMISSION WATER MAIN

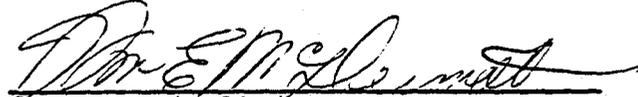
(C.A.P. PLANT TO CRISMON RESERVOIR)

PROJECT NO. 85-18

ADDENDUM NO. 2

The bid date is hereby changed to October 24, 1985, at 3:30 p.m.

I acknowledge receipt of this revision and will use it for bidding purposes on the above project.


Contractor's Signature

10-24-85
Date

Note: A signed copy of this Addendum is to be returned with the Contractor's Proposal. The Contractor should also acknowledge this Addendum in the space provided on the Proposal.

DEAN SLOAN
Public Works Director

CITY OF MESA
MESA, ARIZONA

EAST BROWN ROAD TRANSMISSION WATER MAIN

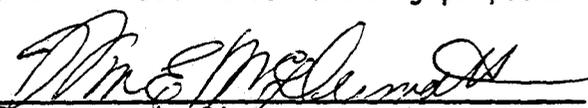
C.A.P. PLANT TO CRISMON RESERVOIR

PROJECT NO. 85-18

ADDENDUM NO. 3

SEE ATTACHED SHEETS

I acknowledge receipt of this revision and will use it for bidding purposes on the above project.


Contractor's Signature

10-24-85
Date

Note: A signed copy of this Addendum is to be returned with the Contractor's Proposal. The Contractor should also acknowledge this Addendum in the space provided on the Proposal.

DEAN SLOAN
Public Works Director

CITY OF MESA, ARIZONA
CITY PROJECT NO. 85-18
BROWN ROAD TRANSMISSION MAIN

ADDENDUM NO. 3

A. SCOPE. This Addendum No. 3 consists of pages AD3-1 through AD3-3. The following additions shall be made to the contract Drawings and Specifications for this project.

B. ADDENDUM NO. 1

1. Item 10.1. Change Sta. "163+89.19" to Sta. "163+86.19"
2. Item 10.3. Change Modulus of Elasticity from " 3.0×10^6 " to " 3.0×10^6 "
3. Attached Bid Schedule. Change Item 10, Miscellaneous Concrete unit "sq. yds." to "cu. yds."
4. Sheet 31 of 36. Add in the profile the AT & T Fiber Optic Cable at 42" depth at approx. Sta. 170+74 and approx. Sta. 172+88.

C. SPECIFICATIONS.

1. Section 1B. MEASUREMENT AND PAYMENT.

1.1 Page 1B-1, Paragraph 1B-2. Add the following sentence to the paragraph: "The unit price bid for the transmission main shall include fence removal and replacement."

2. Section 13A. INSTRUMENTATION AND METERING EQUIPMENT.

2.1 Page 13A-1, Paragraph 13A-2. SUPPLIER'S QUALIFICATIONS. Delete all paragraphs and subparagraphs and substitute the following:

"The entire system shall be designed, coordinated, and supplied by an experienced instrumentation supplier who is regularly engaged in the business of designing and building instrument, metering, and control systems. The supplier will be required to prove his qualifications by submitting the following:

That he has the required financial capability.

The names of manufacturers whose products are normally supplied and the type of business relationship with each.

That he maintains a qualified technical staff.

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(11785.PLD)

AD3-1

That he has and will maintain competent service personnel to service the equipment furnished.

The names of at least three references who are users of similar equipment furnished by the supplier."

2.2 Page 13A-3, Paragraph 13A-7.01. Electronic Pressure Transmitter with Local Indicator. Delete the first sentence of the first paragraph and substitute the following:

"The transmitter shall be Fisher & Porter, Foxboro, Honeywell, or equal. The transmitter shall have all solid-state electronic circuitry and shall be of the 2 wire type, which requires no direct power connection to the transmitter."

2.3 Page 13A-4, Paragraph 13A-7.02.01. Strainers. Delete all paragraphs and substitute the following:

"A strainer shall be provided ahead of the flowmeter as indicated on the drawings. The strainer shall be as approved by flowmeter manufacturer. Arrows shall be cast on the sides of each strainer body to indicate the direction of flow. The blowoff from each strainer shall be equipped with a shutoff valve."

D. DRAWINGS.

1. Sheet 28 of 36.

1.1 In the profile, change the " 15' " dimension from north edge of vault to blind flange to " 21' ", and change the Restrained Joint " 40' " dimension from Sta. 157+57.88 to the blind flange to " 61' ".

2. Sheet 34 of 36.

2.1 In Detail Section 1, delete cast iron manhole steps as per MAG 428 and replace with Fiberglass Ladder as indicated in Addendum No. 1, Figure 2-AD1, and as specified in Addendum No. 1, item 11.3.

2.2 In Contract Customer Metering Station Plan, add the phrase "and equipped with Ladder Up safety post" to the note reading "Bilco K-4 alum. 3'-0" sq. hatch, modified w/recessed hasp for a K-type door as made for Bilco".

2.3 In Contract Customer Metering Station Site Plan, Detail A, add the following note:

"It is the responsibility of the Contractor to order and pay for electrical services and to ensure the services are installed with the completion of the project."

I acknowledge receipt of this addition and will use it for bidding purposes on the above project.

Contractor's Signature

Date

Note: A signed copy of this Addendum is to be returned with the Contractor's Proposal. The Contractor should also acknowledge this Addendum in the space provided on the Proposal.

DEAN SLOAN
Public Works Director

(OCTOBER 18, 1985)
(MESA, ARIZONA)
(11785.PLD)

AD3-3

CITY OF MESA
MESA, ARIZONA

EAST BROWN ROAD TRANSMISSION WATER MAIN
C.A.P. PLANT TO CRISMON RESERVOIR

Project No. 85-18

PROPOSAL to the Public Works Director of the City of Mesa,

In compliance with the Advertisement for Bids, by the Public Works Director, the undersigned bidder:

Having examined the contract documents, site of work, and being familiar with the conditions to be met, hereby submits the following Proposal for furnishing the material, equipment, labor, and everything necessary for the completion of the work listed and agrees to execute the contract documents and furnish the required bonds and certificates of insurance for the completion of said work, at the locations and for the prices set forth on the inside pages of this form.

Understands that construction of this project shall be in accordance with all applicable Uniform Standard Specifications and Standard Details except as otherwise required by the project Plans and Special Provisions.

Understands that his Proposal shall be submitted with a Proposal guarantee of cash, certified check, cashier's check, or surety bond for an amount not less than ten per cent (10%) of the amount bid. If a surety bond is used the Bidder must use the form provided with this Proposal.

Agrees that upon receipt of Notice of Award from the City of Mesa, he will execute the contract documents.

Work shall be completed within 180 consecutive calendar days, beginning with the day following the starting date specified in the Notice to Proceed. Said notice will be issued when requested by the Contractor, or, when, in the opinion of the Engineer, sufficient materials are, or will be available for the continuous prosecution of the work.

The Bidder hereby acknowledges receipt of and agrees his Proposal is based on the following Addenda:

Add # 1

Add # 2

Add # 3

CITY OF MESA, ARIZONA
ENGINEERING DEPARTMENT

CONTRACTOR'S AFFIDAVIT
REGARDING

SETTLEMENT OF CLAIMS

Part 100, Section 109, General Conditions

Mesa, Arizona
Date _____

Project No. 85-18

To the City of Mesa, Arizona

This is to certify that all lawful claims for materials, rental of equipment and labor used in connection with the construction of the above project, whether by subcontractor or claimant in person, have been duly discharged.

The undersigned, for the consideration of \$ _____, as set out in the final pay estimate, as full and complete payment under the terms of the contract, hereby waives and relinquishes any and all further claims or right of lien under, in connection with, or as a result of the above described project. The undersigned further agrees to indemnify and save harmless the City of Mesa against any and all liens, claims of liens, suits, actions, damages, charges and expenses whatsoever which said City may suffer arising out of the failure of the undersigned to pay for all labor, performance and materials furnished for the performance of said installation.

Signed and dated at _____, this _____ day of _____, 19____.

Contractor

By

STATE OF ARIZONA)
)ss
County of Maricopa)

The foregoing instrument was subscribed and sworn to before me this _____ day of _____, 19____.

Notary Public

My Commission Expires:

CERTIFICATE OF INSURANCE

ISSUE DATE (MM/DD/YY)

11/25/85

PRODUCER

Fred. S. James & Co. of Oregon
111 SW Columbia
Portland, Oregon 97201

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

COMPANIES AFFORDING COVERAGE

COMPANY LETTER **A** Home Insurance Co.

COMPANY LETTER **B** Mission National Ins. Co.

COMPANY LETTER **C** LUA

COMPANY LETTER **D** St. Katherine

COMPANY LETTER **E**

INSURED

Sunflower Construction, Inc.
Marshall Associated Contractors, Inc.
9132 W. Cactus Road
Peoria, Arizona 85345

COVERAGES

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS, AND CONDITIONS OF SUCH POLICIES.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIABILITY LIMITS IN THOUSANDS		
						EACH OCCURRENCE	AGGREGATE
A	GENERAL LIABILITY	GL1487427	4/1/85	4/1/86	BODILY INJURY	\$ 500	\$ 500
	<input checked="" type="checkbox"/> COMPREHENSIVE FORM				PROPERTY DAMAGE	\$	\$
	<input checked="" type="checkbox"/> PREMISES/OPERATIONS UNDERGROUND EXPLOSION & COLLAPSE HAZARD				BI & PD COMBINED	\$	\$
	<input checked="" type="checkbox"/> PRODUCTS/COMPLETED OPERATIONS				PERSONAL INJURY		\$ 500
	<input checked="" type="checkbox"/> CONTRACTUAL						
	<input checked="" type="checkbox"/> INDEPENDENT CONTRACTORS						
	<input type="checkbox"/> BROAD FORM PROPERTY DAMAGE						
<input checked="" type="checkbox"/> PERSONAL INJURY							
A	AUTOMOBILE LIABILITY	GL1487427	4/1/85	4/1/86	BODILY INJURY (PER PERSON)	\$	
	<input checked="" type="checkbox"/> ANY AUTO				BODILY INJURY (PER ACCIDENT)	\$	
	<input checked="" type="checkbox"/> ALL OWNED AUTOS (PRIV. PASS.)				PROPERTY DAMAGE	\$	
	<input checked="" type="checkbox"/> ALL OWNED AUTOS (OTHER THAN PRIV. PASS.)				BI & PD COMBINED	\$ 500	
	<input checked="" type="checkbox"/> HIRED AUTOS						
	<input checked="" type="checkbox"/> NON-OWNED AUTOS						
<input type="checkbox"/> GARAGE LIABILITY							
B	EXCESS LIABILITY	MNO47574	4/1/85	4/1/86	BI & PD COMBINED	\$ 2,000	\$ 2,000
	<input checked="" type="checkbox"/> UMBRELLA FORM						
	<input type="checkbox"/> OTHER THAN UMBRELLA FORM						
C	WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY	LUA 85-86	10/1/85	10/1/86	STATUTORY		
					\$ 100 (EACH ACCIDENT)		
					\$ 500 (DISEASE-POLICY LIMIT)		
					\$ 100 (DISEASE-EACH EMPLOYEE)		
D	OTHER Broad Form Property Damage	JOL1304	4/1/85	4/1/86	\$250. Ea Occur. \$250. Agg.		

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

RE: East Brown Road Transmission Main, Project # 85-18

CERTIFICATE HOLDER

City of Mesa, Arizona

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

David A. Lewis *David A. Lewis*



This endorsement forms a part of the policy to which attached, effective on the inception date of the policy unless otherwise stated herein.

(The following information is required only when this endorsement is issued subsequent to preparation of policy.)

Endorsement effective 11/25/85

Policy No. GL1487427

Endorsement No.

Named Insured Sunflower Construction, Inc.

Additional Premium \$ _____

Countersigned by David A Lewis
(Authorized Representative)

This endorsement modifies such insurance as is afforded by the provisions of the policy relating to the following:

**COMPREHENSIVE GENERAL LIABILITY INSURANCE
MANUFACTURERS AND CONTRACTORS LIABILITY INSURANCE**

ADDITIONAL INSURED

(Owners or Contractors)

Schedule

Name of Person or Organization
(Additional Insured)

City of Mesa, Arizona

Location of Covered Operations

East Brown Road Transmission Main

Advance Premium

	Premium Bases	Rates	Advance Premium
Bodily Injury Liability	Cost	\$100 of cost	\$
Property Damage Liability	Cost	\$100 of cost	\$
Excluded			
Total Advance Premium			\$

It is agreed that:

- The "Persons Insured" provision is amended to include as an insured the person or organization named above (hereinafter called "additional insured"), but only with respect to liability arising out of (1) operations performed for the additional insured by the named insured at the location designated above or (2) acts or omissions of the additional insured in connection with his general supervision of such operations.
- None of the exclusions of the policy, except exclusions (a), (c), (f), (g), (i), (j) and (m), apply to this insurance.
- Additional Exclusions** This insurance does not apply:
 - to bodily injury or property damage occurring after
 - all work on the project (other than service, maintenance or repairs) to be performed by or on behalf of the additional insured at the site of the covered operations has been completed or
 - that portion of the named insured's work out of which the injury or damage arises has been put to its intended use by any person or organization other than another contractor or subcontractor engaged in performing operations for a principal as a part of the same project;
 - to bodily injury or property damage arising out of any act or omission of the additional insured or any of his employees, other than general supervision of work performed for the additional insured by the named insured;
 - to property damage to
 - property owned or occupied by or rented to the additional insured,
 - property used by the additional insured,
 - property in the care, custody or control of the additional insured or as to which the additional insured is for any purpose exercising physical control, or
 - work performed for the additional insured by the named insured.
- Additional Definition** When used in reference to this insurance, "work" includes materials, parts and equipment furnished in connection therewith.

ADDITIONAL INSUREDS

ENDORSEMENT

Attached to and forming part of Policy No. MN047574

Issued to Sunflower Construction, Inc.

Endorsement effective 11/25/85

It is understood and agreed that City of Mesa, Arizona

are additional Insureds under this Policy but only in regard to claims arising out of or in connection with work being performed by

Sunflower Construction, Inc.

under contract for East Brown Road Transmission Main, Project

85-18

However, it is specifically agreed that in regard to additional Insured (s) above, this Policy does not cover any liability arising out of professional services, including the preparation or approval of maps, plans, opinions, reports, surveys, designs, specifications, and supervisory inspections or engineering services.

It is further understood and agreed that the foregoing shall not act to increase the Company's limit of liability under this Policy.

Prior to the cancellation of this Policy 30 days

written notice will be given by; Mission National Insurance Co.

on behalf of the Company to City of Mesa, Arizona

DATED: 11/25/85

ADDITIONAL INSUREDS

ENDORSEMENT

Attached to and forming part of Policy No. JOL1304

Issued to Sunflower Construction, Inc.

Endorsement effective 11/25/85

It is understood and agreed that City of Mesa, Arizona

are additional Insureds under this Policy but only in regard to claims arising out of or in connection with work being performed by

Sunflower Construction, Inc.

under contract for East Brown Road Transmission Main, Project #

85-18

However, it is specifically agreed that in regard to additional Insured (s) above, this Policy does not cover any liability arising out of professional services, including the preparation or approval of maps, plans, opinions, reports, surveys, designs, specifications, and supervisory inspections or engineering services.

It is further understood and agreed that the foregoing shall not act to increase the Company's limit of liability under this Policy.

Prior to the cancellation of this Policy 30 days

written notice will be given by; St. Katherine Insurance Co.

on behalf of the Company to City of Mesa, Arizona

DATED: 11/25/85

CERTIFICATE OF INSURANCE

CITY OF MESA, ARIZONA
Box 1466, Mesa, AZ 85201

For jobs
\$100,000
and over

The undersigned certifies that the following insurance policies have been issued on behalf of:

Name of Insured: Sunflower Construction Inc.

Address of Insured: 9132 West Cactus Road, Peoria, Arizona 85345

Project Name or Number: East Brown Road Transmission main, Project No. 85-18

Type of Insurance	Carrier	Policy No.	Policy Period	Minimum Limits of Liability
1. Workmen's Compensation				Statutory
2. Employer's Liability				\$1,000,000 each occurrence.
3. Comprehensive Automobile Liability* (Non-owned auto hazard)				\$1,000,000 B.I. \$500,000 P.D. each occurrence.
4. Contractual Liability*				\$1,000,000 each occurrence.
5. Comprehensive General Liability*				\$1,000,000 each occurrence
6. Umbrella (or other excess form)				
7. Course of Construction	When the project includes construction of a new, or modification of an existing structure for the City, a course of construction policy covering the perils of fire and extended coverage in the amount of the contract price shall be provided. The City is to be named therein as "Loss Payee" and the insurer shall waive subrogation rights against the City.			

*3. The comprehensive auto liability insurance includes the owned, non-owned and hired auto hazards.

*4. The contractual liability insurance applied to the hold-harmless provisions of the contract between the named insured and the City of Mesa, for the project described above, as well as any liability assumed in construction agreements the insured makes in connection with insured operations.

*5. The comprehensive general liability insurance covers explosion, collapse and underground (XCU) hazards, and the products and completed operations hazards. It also includes broad form property damage.

Except for workmen's compensation insurance, the City of Mesa is added as an additional insured as respects work done for the City of Mesa by the named insured. It is agreed that any insurance maintained by the City of Mesa will only apply in excess of the coverages and limits described above.

It is further agreed that none of these policies shall expire or be cancelled or changed until all work has been completed and the project has been accepted by the City of Mesa. If a policy does expire during the life of the Contract, a renewal Certificate of the required coverage will be sent to the City of Mesa not less than five (5) days prior to expiration date. If a policy is to be cancelled or changed, a proper notice of such action will be sent to the City not less than thirty (30) days prior to any such action by the insurance company.

This Certificate is not valid unless countersigned by any authorized representative of the Insurance Company.

Date _____

Insurance Company Name

Signature

Countersigned

SPECIAL PROVISIONS - LIST OF SUBJECTS

- SP-1 STANDARD SPECIFICATIONS AND STANDARD DETAILS.
- SP-2 DEFINITIONS.
- SP-3 REVIEW OF THE SITE.
- SP-4 MARICOPA COUNTY HIGHWAY DEPARTMENT PERMIT.
- SP-5 COUNTY HEALTH DEPARTMENT.
- SP-6 STAKING AND TRAFFIC REGULATIONS.
- SP-7 ENGINEERING INSPECTION.
- SP-8 CITY SALES TAX.
- SP-9 RELOCATION AND/OR ADJUSTMENT OF EXISTING FACILITIES, SERVICES, AND ACCESS.
- SP-10 INSURANCE REQUIREMENTS.
- SP-11 CONTRACTOR'S AFFADAVIT.
- SP-12 SPECIAL NOTICE TO WATER LINE CONTRACTORS.
- SP-13 NECESSARY WORK DONE BY CITY FORCES.
- SP-14 EQUIPMENT RENTAL RATES FOR ACTUAL COST WORK.
- SP-15 CONSTRUCTION WATER.
- SP-16 TEST HOLES.
- SP-17 UNDERGROUND INSTALLATIONS.
- SP-18 OTHER CONSTRUCTION CONTRACTS.
- SP-19 CITY GAS MAIN.
- SP-20 ITEMS FURNISHED BY OWNER.
- SP-21 OVERHEAD POWER.
- SP-22 UNDERGROUND POWER.
- SP-23 PREPARATION FOR SHIPMENT.

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(11785.PLD)

SP-LIST-1

- SP-24 FIELD VERIFICATION.
- SP-25 POTHOLING EXISTING UTILITY LINES.
- SP-26 UNFAVORABLE CONSTRUCTION CONDITIONS.
- SP-27 ALTERNATIVES.
- SP-28 APPLICABLE CODES.
- SP-29 REFERENCE STANDARDS.
- SP-30 ABBREVIATIONS AND SYMBOLS.
- SP-31 INDEMNIFICATION.

(MESA, ARIZONA)
(11785.PLD)

SP-LIST-2

SPECIAL PROVISIONS

SP-1 STANDARD SPECIFICATIONS AND STANDARD DETAILS. Attention is called to the fact that the City of Mesa is now operating under the latest revision of the 1979 edition of the Uniform Standard Specification for Public Works construction, published by the Maricopa Association of Governments as amended by the City of Mesa on February 1, 1985, and is herewith incorporated by reference and made a part hereof. Copies of these Standard Specifications may be obtained from the Engineering Permit Section for Fifteen Dollars (\$15.00) per set. A Mesa amendment to the Standard Specifications will be included with each set. Additional copies of the Mesa amendment may be obtained at the above location at NO COST.

The City of Mesa is also operating under the latest revision of the 1979 edition of Standard Details as published by the Maricopa Association of Governments as amended by the City of Mesa on February 5, 1985. Copies of these Standard Details may be obtained from the Engineering Permit Section for Twenty Dollars (\$20.00) per set. A City of Mesa amendment may be obtained at NO COST.

Reference to Standard Specifications and Standard Details shall mean the above documents and corresponding City of Mesa amendments. Any provisions of the Standard Specifications and Standard Details which pertain to a nonexistent condition and is not applicable to the Work to be performed, or which conflicts with any of the Special Provisions or Specifications contained herein or the Drawings shall have no meaning in the Contract Documents and shall be disregarded.

The Standard Specifications will be amended as follows:

Section 105.10 INSPECTION OF WORK

Inspection of the Work by the Engineer or his authorized representative shall not be considered as direct control of the individual workman and his work. The direct control shall be solely the responsibility of the Contractor's foreman and superintendent.

The Engineer shall be permitted to inspect all materials, and each part or detail of the Work at any time for the purpose of expediting and facilitating the progress of the work. He shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

Any work done or materials used without inspection by an authorized Contracting Agency representative may be ordered

removed and replaced at no additional cost to the Contracting Agency. Failure to reject any defective work or materials shall not be in any way prevent later rejection when such defect is discovered nor obligate the Engineer to final acceptance.

When any unit of government or political subdivision is to pay a portion of the cost of the work covered by the contract, its respective representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision a party to the contract, and shall in no way interfere with the rights of either party to the contract.

- SP-2 DEFINITIONS. Supplementing the Definition of terms contained in the Standard Specifications; words, phrases or other expressions used in these Special Provisions and Technical Specifications shall have meanings as follows:
- o "Consulting Engineer" shall mean the firm of Black & Veatch Engineers - Architects, 3020 E. Camelback Rd., Suite 155, Phoenix, Arizona 85016, or its duly authorized agents.
 - o "Drawings" shall be synonymous with the term "plans" as defined in the Standard Specifications.
- SP-3 REVIEW OF THE SITE. The Contractor is advised that it is his responsibility to review the locations of this project and be familiar with each site prior to submitting bid.
- SP-4 MARICOPA COUNTY HIGHWAY DEPARTMENT PERMIT. All work within the Maricopa County Right-of-way will require a County Highway Department permit. It shall be the Contractor's responsibility to obtain this permit and comply with its requirements.
- SP-5 COUNTY HEALTH DEPARTMENT PERMIT. The Contractor is advised that an Excavation and Dirt Moving Permit is required by the Maricopa County Health Department. It shall be the Contractor's responsibility to obtain this permit and comply with its requirements.
- SP-6 STAKING AND TRAFFIC REGULATIONS. The City of Mesa will perform staking and shall require 48-hour notice. Call Engineering at 834-2554 or 834-2555.

It shall be the responsibility of the Contractor to comply with the City of Mesa Traffic Barricade Manual for those portions of this project that are inside the City limits. The cost for any damage to

traffic signal equipment (Loop detectors, pull boxes, conduit, etc.) is the Contractor's responsibility. All repair work will be done by the City of Mesa Traffic Signal group, and costs charged to the Contractor.

SP-7 ENGINEERING INSPECTION. The Owner will appoint (either directly or through the Consulting Engineer) such inspectors as the Owner deems proper to inspect the materials furnished and the work performed for compliance with the drawings and specifications. The Contractor shall furnish all reasonable assistance required by the Engineer, or inspectors, for the proper inspection of the Work. Should the Contractor object to any interpretation of the contract by an inspector, the Contractor may make written appeal to the Engineer for a decision.

Inspectors shall have the authority and duties stipulated in the Standard Specifications.

SP-8 CITY SALES TAX. The Contractor is advised that he is not required to pay City Sales Tax on any contracting activity done for the City, and this cost should not be included in the bid prices.

SP-9 RELOCATION AND/OR ADJUSTMENT OF EXISTING FACILITIES, SERVICES, AND ACCESS. If relocation or adjustment of existing facilities is noted on the drawings, this is intended to include the relocation or adjustment of items appurtenant to the noted piece of work, just as if they were specifically called out. If these appurtenant items are lost or broken during construction, they shall be replaced by the Contractor with items of equal or better quality.

SP-10 INSURANCE REQUIREMENTS. The insurance forms attached to these specifications will be required for use on this project. Note that one form applies to contract amounts less than \$100,000.00, and one to contract amounts equal to or in excess of \$100,000.00. Use whichever form is applicable to the contract amount officially awarded by the City. Except for workman's comprehensive insurance, the Consulting Engineer shall be named as an additional insured party under the Contractors insurance policies.

SP-11 CONTRACTOR'S AFFIDAVIT. Contractor shall submit a signed copy of the Contractor's affidavit (as attached to these specifications) prior to final payment.

SP-12 SPECIAL NOTICE TO WATER LINE CONTRACTORS. Contractor is advised that City of Mesa Utilities Division requires a notice of three (3) working days to coordinate the necessary exercising and checking of valves prior to shutting off any water valves for tie-ins.

Contractor shall review water maps (plats) and submit a written request to the Inspector listing the valves that need to be exercised and when they are to be shut off for any tie-ins on his project. Request shall be sent in time to allow the three (3) day time limit noted above.

SP-13 NECESSARY WORK DONE BY CITY FORCES. During the Construction of this project, if the contractor fails to comply with a request of the Inspector or is unable to comply with said request, and it is necessary for City forces to do work that is normally the Contractor's responsibility, the City shall be justified in billing the Contractor. Each incident requiring work by City forces shall be covered by a separate billing.

The amount of each billing shall be either \$250.00 or the actual accumulated charges for employees' time, materials, and equipment, whichever is greater. Employees' time will be billed at each individual's hourly rate plus the applicable City overhead rate. Any materials used will be billed at cost. Equipment rates will be based on the most recent schedule of equipment rental rates for forced account work, as published by the the Arizona Department of Transportation.

SP-14 EQUIPMENT RENTAL RATES FOR ACTUAL COST WORK. Compensation for equipment used on actual cost work of MAG U.S.S. section 109.5.1 shall be paid in accordance with the August 16, 1982 Arizona Department of Transportation, Highways Division, "Requirements for the Utilization of the schedule of equipment rental rates for equipment used on Force Account Work", except for the following:

- 1) Sheet 1: Only the "Rental Rate Blue Book for Construction Equipment" will be used. All other equipment not covered by this publication will need to be agreed upon by the engineer prior to it's use.
- 2) Sheet 2 last paragraph: The additional fifteen percent will be deleted for equipment used between 40 to 176 hours.
- 3) Sheet 3 first paragraph: Equipment brought in exclusively for the force account work shall be paid the same as equipment already on the project, unless otherwise approved by the engineer.
- 4) Sheet 3 last paragraph: The Blue Book area percentage adjustment will apply in determining the rental rates.
- 5) Sheet 4 last paragraph: Standby time will not be paid unless otherwise approved by the engineer. Contractor must notify the engineer and obtain engineers approval prior to the start of any standby time.
- 6) Sheet 5 and 6, sections 3-c, 3-d and 3-e: the mark up for overhead and profit will follow MAG U.S.S. section 109.5.4.

SP-15 CONSTRUCTION WATER. No bid item for construction water will be listed in the Bid Schedule. The contractor shall estimate the quantity of water to be used and include the cost in the total bid package.

The contractor shall obtain a fire hydrant meter from Public Works Services and all construction water shall be obtained through the hydrant meter. Contractor shall pay all fees related to the hydrant meter and all water bills for construction water.

For water line installations, whenever possible, the new water line shall be filled through the hydrant meter. If this is not feasible the construction inspector will tabulate the number of times the water line is filled and estimate the amount of water used for filling and flushing. This quantity shall be added to other construction water charges that are billed to the contractor.

SP-16 TEST HOLES. Test holes have been made along the route of the pipeline. The locations of test holes are indicated on the drawings. Logs of the test holes are bound as an appendix to the specifications.

Test hole information represents subsurface characteristics to the extent indicated, and only for the point location of the test hole. Each Bidder shall make his own interpretation of the character and condition of the materials which will be encountered between test hole locations. Each prospective Bidder may, at his own expense, make additional surveys and investigations as he may deem necessary to determine conditions which will affect performance of the work.

SP-17 UNDERGROUND INSTALLATIONS. Existing underground installations are indicated on the drawings only to the extent such information was made available to or discovered by the Consulting Engineer in preparing the drawings. There is no guarantee as to the accuracy or completeness of such information, and all responsibility for the accuracy and completeness thereof is expressly disclaimed.

Generally, service connections are not indicated on the drawings. Contractor shall be responsible for discovery of existing underground installations, in advance of excavating or trenching, by contacting all local utilities and by prospecting.

SP-18 OTHER CONSTRUCTION CONTRACTS. Work at the site performed by others under separate contracts includes the following:

City Project No. 83-01, Water Treatment Plant. City Project No 83-01 consists of construction of the Mesa Water Treatment Plant near Brown and Sossaman Roads. The water treatment plant contract will connect to the water transmission main as specified herein.

City Project No. 85-26, Crismon Road Reservoir. City Project No. 85-26 consists of construction of a water storage reservoir west of Crismon Road approximately one-half mile north of Brown Road. The reservoir contract will connect to the water transmission mains as specified herein.

SP-19 City Gas Main. A gas main will be installed by the City of Mesa in accordance with Standard Detail M-58. The gas main will be installed in the same trench as the 36 inch water transmission main in the location shown on the drawings. Contractor shall be responsible for all trench backfilling in accordance with Standard Detail M-58.

SP-20. ITEMS FURNISHED BY OWNER. A remote terminal unit (RTU) to be installed in the contract customer metering station as shown on the drawings will be furnished by Owner for installation by Contractor.

Specifications under which the equipment was purchased are available for inspection at the office of the Consulting Engineers.

Shop and installation drawings pertaining to the equipment and accessories shall be available to Contractor upon completion of review by the Consulting Engineer.

SP20.01 Delivery. The RTU furnished by Owner will be delivered to Owner's storage yard. The RTU will be available to Contractor, as required to maintain his construction schedule.

SP20.02 Responsibility. Contractor's responsibility for the RTU furnished by Owner shall begin at the point of delivery on acceptance by Contractor. Contractor shall carefully examine the equipment prior to acceptance and shall reject all defective items. Owner reserves the right, however, to accept items rejected by Contractor and to authorize its installation in the Work.

Defective materials and equipment discovered after installation and prior to final acceptance of the work, where the defect is of a nature not detectable by visual examination and other appropriate field inspection methods, will be replaced by Owner, together with such additional materials and supplies as may be necessary for its replacement. Contractor shall, at his own expense, furnish all

necessary tools, equipment, and appliances, and perform all necessary labor, for the removal and replacement of such defective items in a manner acceptable to Engineer.

If the RTU furnished by Owner disappears or is damaged after its acceptance by Contractor, it shall be replaced by and at the expense of Contractor. Replacements shall conform to the original purchase specifications.

SP-21 OVERHEAD POWER. The Salt River Project maintains energized aerial electrical power lines in the immediate vicinity of this project. Do not consider these lines to be insulated. Construction personnel working in proximity to these lines are exposed to an extreme hazard from electrical shock. Contractors, their employees, and all other construction personnel working on this project shall be warned of the danger and instructed to take adequate protective measures, including maintaining a minimum ten (10) feet clearance between the lines and all construction equipment and personnel. (See OSHA Std. 1926.550(a)15) As an additional safety precaution, contractors shall also be instructed to call the Salt River Project at 273-8888 to arrange, if possible, to have these lines de-energized or relocated when the work reaches their immediate vicinity. The cost of such temporary arrangements shall be borne by the Contractor. The District can often respond to such requests if two days advance notice is given, but some situations may require up to 60 days lead time for relocation or other arrangements.

SP-22 UNDERGROUND POWER. The Salt River Project maintains certain energized, underground electrical power lines in the immediate vicinity of this project, and these lines have been noted herein as potential conflicts. These power lines represent an extreme hazard from electrical shock to any construction personnel or equipment coming in contact with them. Arizona law requires all parties planning excavations in public rights-of-way to contact all utility firms for location of their underground facilities. Contractors must be instructed to call the Blue Stake Center (263-1100) for such location service. Contractors, their employees, and all other personnel working near any underground power lines must be warned to take adequate protective measures. (See: OSHA std. 1926-651(a)). As an additional safety precaution, Contractors shall also be instructed to call the Salt River Project at 273-8888 to arrange, if possible, to have these lines de-energized when the work reaches their immediate vicinity. The cost of such temporary arrangements shall be borne by the Contractor. If de-energization is feasible, the Contractor shall give the Salt River Project at least two day's advance notice of his requirement.

SP-23 PREPARATON FOR SHIPMENT. All materials and equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

SP-24 FIELD VERIFICATION. The Contractor shall verify the stationing, elevations, and type of pipe to be matched at all field closure points, prior to fabrication of the pipe.

SP-25 POTHOLING EXISTING UTILITY LINES. It shall be the responsibility of the Contractor to pothole all existing utilities ahead of his construction, to allow for any necessary adjustment in gradeline. No compensation will be made for this item.

SP-26 UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, wet ground, or other unsuitable construction conditions, the Contractor shall confine his operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the work in a proper and satisfactory manner.

SP-27 ALTERNATIVES. The work required under the base Bid is indicated in the specifications and on the drawings. All requirements specified or indicated also apply to each alternative selected by Owner. The following alternative is provided for in the Proposal.

Alternative A:

Installation of a remote terminal unit (RTU) in the contract customer metering station as shown on the drawings.

SP-28 APPLICABLE CODES. References in the Contract Documents to local codes mean:

Uniform Building Code, 1979
Uniform Plumbing Code, 1979
Uniform Mechanical Code, 1979
National Electric Code, 1981

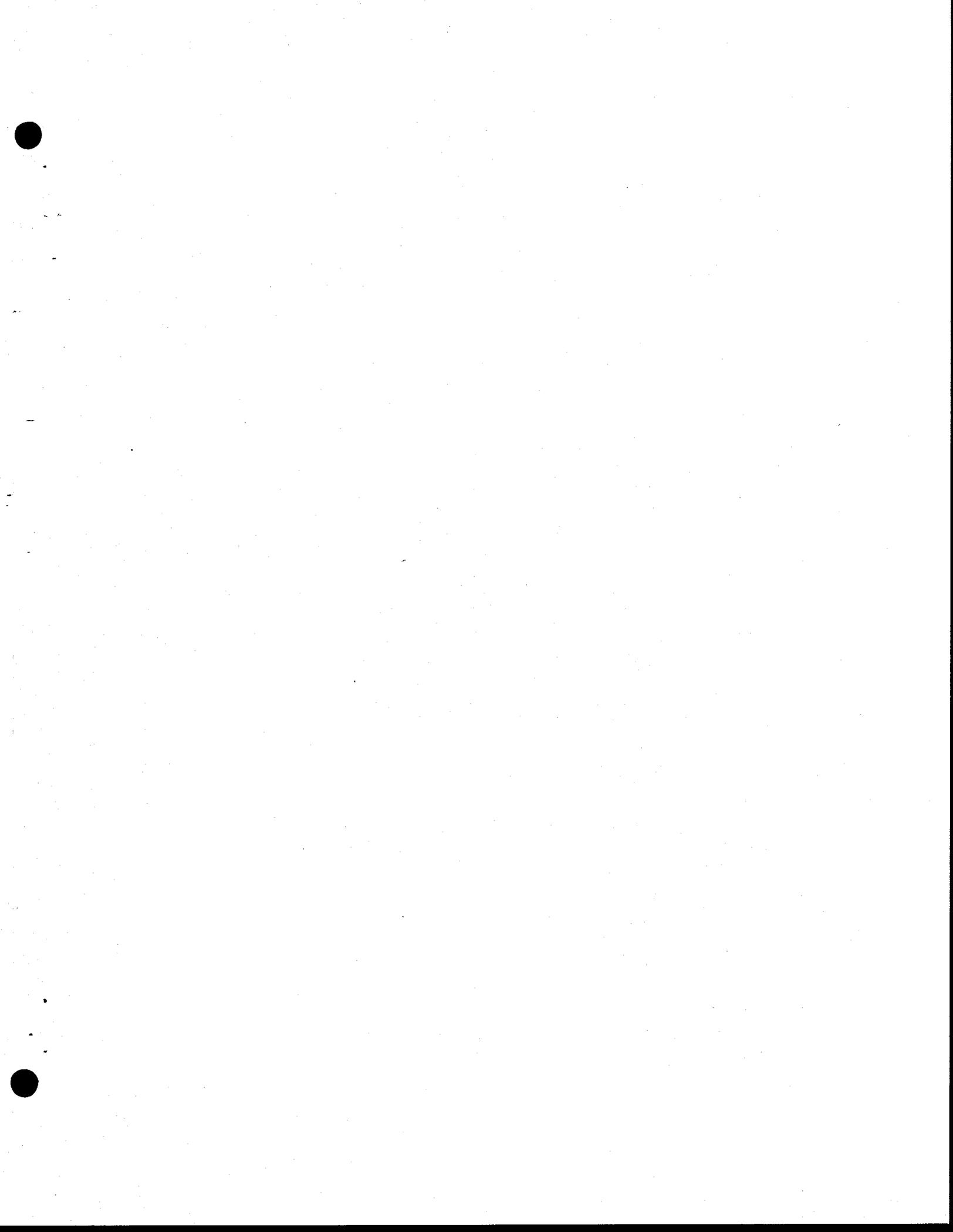
SP-29 REFERENCE STANDARDS. Reference to the standards of any technical society, organization, or association, or to codes of local or state authorities, shall mean the latest standard, code, specification, or tentative standard adopted and published at the date of receipt of bids, unless specifically stated otherwise.

SP-30 ABBREVIATIONS AND SYMBOLS. Abbreviations used in the Contract

Documents are defined as follows:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
Fed Spec	Federal Specifications
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NPT	National Pipe Thread
PS	Product Standard
UL	Underwriters' Laboratories
US	U. S. Bureau of Standards

SP-31 INDEMNIFICATION. In the MAG Standard Specifications, for example sections 103.6.2, 105.7 and 107.3, the Consulting Engineer shall be included as an indemnified party.



Section 1A - SUBMITTALS

1A-1. CONSTRUCTION SURVEY DATA. All field books, notes, and other data developed by Contractor as part of the Work shall be available to Engineer for examination throughout the construction period. All such data shall be submitted to Engineer with the other documentation required for final acceptance of the Work.

1A-2. SHOP DRAWINGS AND ENGINEERING DATA. Engineering data covering all equipment and fabricated materials which will become a permanent part of the Work under this contract shall be submitted to the Consulting Engineer for review. These data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

All submittals regardless of origin, shall be stamped with the approval of Contractor and identified with the name and number of this contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor's stamp of approval is a representation to Owner and the Consulting Engineer that Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that he has reviewed or coordinated each submittal with the requirements of the Work and the Contract Documents.

All deviations from the Contract Documents shall be identified on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

Contractor shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions previously noted by the Consulting Engineer have been taken into account. In the event that more than one resubmission is required because of failure of Contractor to account for exceptions previously noted, Contractor shall reimburse Owner for the charges of the Consulting Engineer for review of the additional resubmissions.

Any need for more than one resubmission, or any other delay in obtaining the Consulting Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time unless delay of the Work is directly caused by a change in the Work authorized by a Change Order or by failure of the Consulting Engineer to return any submittal within 21 days after its receipt in the Consulting Engineer's office.

The Consulting Engineer's review of drawings and data submitted by Contractor will cover only general conformity to the drawings and specifications, external connections, and dimensions which affect the layout. The Consulting Engineer's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. The Consulting Engineer's review of submittals shall not relieve Contractor from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the Contract Documents.

Five copies (or one reproducible copy) of each drawing and necessary data shall be submitted to the Consulting Engineer. The Consulting Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.,) to indicate the sequence of the resubmittal.

When the drawings and data are returned marked NOT ACCEPTABLE or RETURNED FOR CORRECTION, the corrections shall be made as noted thereon and as instructed by the Consulting Engineer and five corrected copies (or one corrected reproducible copy) resubmitted.

When corrected copies are resubmitted, Contractor shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by the Consulting Engineer on previous submissions.

When the drawings and data are returned marked EXCEPTIONS NOTED, NO EXCEPTIONS NOTED, or RECORD COPY, no additional copies need be furnished.

1B-3. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied for all valves, transmitters, meters and other equipment requiring maintenance or other attention.

1B-4. LAYOUT DATA. Contractor shall keep neat and legible notes of measurements and calculations made by him in connection with the layout of the Work. Copies of such data shall be furnished to the Engineer for use in checking Contractor's layout.

Section 1B - MEASUREMENT AND PAYMENT

1B-1. SCOPE. This section covers methods of measurement and payment for items of Work not covered by the Standard Specifications.

1B-2. PIPE. In addition to stipulations in the Standard Specifications, pipe length measurements shall begin and end at the payment limits for valve manholes as indicated on the drawings. Also, the unit price bid for the transmission main shall include the corrosion potential metering system.

1B-3. VALVE VAULTS. Payment will be made at the unit price bid for each manhole, and shall include all costs for providing excavation and backfill, cast-in place reinforced concrete, brick, manhole cover, piping and valve inside the manhole, and all other work required to complete the structure as indicated on the drawings or specified.

1B-4. AIR RELEASE OR AIR RELEASE AND BLOWOFF VALVE ASSEMBLIES. Payment will be made at the unit price bid for each assembly, and shall include cast iron pipe and fittings from the 30 and 36 inch transmission main, excavation and backfill, joint restraint, fire hydrant and all other work required to complete the assembly as indicated on the drawings or specified.

1B-5. CONTRACT CUSTOMER METERING STATION. Payment will be made at the unit price bid for the contract customer metering station, and shall include excavation and trenching; cast-in-place reinforced concrete; 16 inch buried piping, fittings and valves from the 30 inch transmission main and connecting to the structure; piping and fittings inside the station; flow transmitter, pressure transmitter, strainer, turbine meter, gate valves, butterfly valves, access hatch, and all other appurtenances and work required to complete the station as indicated on the drawings or specified.

1B-6. TUNNELS. Where tunneling is required in connection with flood control structure crossings, each crossing shall be measured for payment horizontally along the longitudinal centerline of the tunnel liner. The unit price bid for each crossing in tunnel liner shall include all costs in connection with excavation and backfilling, tunnel liner, the excess cost of installing pipe in tunnel liner above the amount bid for the pipe laid in open trench, all pipe rails, jointing materials, tunneling pits, end closures, and all other work for and in connection with the crossing, not paid for separately.



Section 2A - EXCAVATION AND TRENCHING

2A-1. SCOPE. All excavation and trenching shall conform to the Standard Specifications except as modified herein.

2A-2. CLASSIFICATION OF EXCAVATED MATERIALS. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

2A-3. CLEARING. All clearing shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

2A-4. BLASTING. Blasting or other use of explosives for excavation will not be permitted.

2A-5. STABILIZATION. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms, which are otherwise solid but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than 4 inches; if the required depth exceeds 4 inches, the material shall be furnished and installed as specified for granular fills. Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations indicated on the drawings.

2A-6. TRENCH EXCAVATION.

2A-6.01. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom

of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

2A-6.02. Excavation Below Pipe Subgrade. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, as indicated on Figure 1- 2A, to provide for the installation of granular embedment.

2A-6.03. Bell Holes. Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

2A-7. PIPE EMBEDMENT. Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the requirements shown on Figure 1- 2A and to the following supplementary requirements.

Embedment material shall contain no cinders or other material which may cause pipe corrosion.

2A-7.01. Embedment Classes.

- a. Class A Arch Encasement. Class A arch encasement is not required unless indicated on drawings or improper trenching or unexpected trench conditions require its use as determined by the Engineer.
- b. Class B Bedding. Class B bedding shall be used for all pretensioned concrete cylinder pipe.
- c. Class C Bedding. Class C bedding shall be used for all cast iron pipe.

2A-7.02. Placement and Compaction. Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

Class C embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified.

Whenever crushed rock is used as embedment for 36 inch and larger pipe, the portion above the bottom of the pipe shall be vibrated with a mechanical probe type vibrator during placement to ensure that all spaces beneath the pipe are filled.

2A-8. TRENCH BACKFILL. All trench backfill above pipe embedment shall conform to the following requirements.

A layer of backfill material not more than 8 inches deep may be placed over concrete arch encasement or concrete reaction blocking after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement or blocking until the concrete has been in place for at least 3 days.

2A-8.01. Compacted Backfill. Compacted backfill will be required for the full depth of the trench above the embedment in the following locations:

Where beneath pavements, surfacings, driveways, curbs, gutters, walks, or other surface construction or structures.

Where in street, road, or highway shoulders.

With the approval of the Engineer, compacted backfill may be (a) suitable job excavated material; (b) inundated sand; or (c) graded gravel as described below:

- a. Job Excavated Material. Job excavated material may be used for compacted backfill when the job excavated material is finely divided and free from debris, organic material, cinders or other corrosive material, and stones larger than 3 inches in greatest dimension. Masses of moist, stiff clay shall not be used. Job excavated materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Increased layer thickness may be permitted for noncohesive material if the Contractor demonstrates to the satisfaction of the Engineer that the specified compacted density will be obtained. The method of

compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. Job excavated material shall be compacted to 95 per cent of maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate, or to 70 per cent relative density as determined by ASTM D2049 when that test is appropriate.

- b. Inundated Sand. Sand for inundated sand backfill shall be clean with not more than 25 per cent retained on a No. 4 sieve and not more than 7 per cent passing a No. 200 sieve and shall have an effective size between 0.10 mm and 0.30 mm. Sand shall be deposited in, or placed simultaneously with application of, water so that the sand is inundated during compaction. During placement, the sand shall be compacted by a mechanical probe type vibrator. Inundated sand shall be compacted to 70 per cent relative density as determined by ASTM D2049.
- c. Graded Gravel. Gravel for compacted backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Per Cent Passing by Weight</u>
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. Gravel backfill shall be deposited in uniform layers not exceeding 12 inches in uncompacted thickness. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 70 per cent relative density as determined by ASTM D2049.

2A-8.02. Uncompacted Backfill. Compaction of trench backfill above pipe embedment in locations other than those specified will not be required except to the extent necessary to prevent future settlement.

Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than 2 inches in diameter, debris, cinders, or other corrosive material.

Uncompacted backfill material above embedments shall be placed by methods which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe.

Compact masses of stiff clay or other consolidated material more than one cubic foot in volume shall not be permitted to fall more than 5 feet into the trench unless cushioned by at least 2 feet of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper 18 inches of the trench, nor shall any stone larger than 8 inches in its greatest dimension be placed within 3 feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

2A-9. STRUCTURE BACKFILL. Backfill material around the Contract Customer Metering Station and Valve Vaults shall be deposited in layers not to exceed 8 inches in uncompacted thickness and compacted to at least 95 percent of maximum density at optimum moisture content as determined by ASTM D698. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

2A-10. TESTS. All tests required for materials shall be made according to the Standard Specifications.

2A-11. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

2A-12. TUNNEL EXCAVATION. Pipelines shall be constructed in tunnels of the type designated on the drawings, in conformity with the requirements which follow. Before starting work on any tunnel, detailed drawings, specifications, and other data covering the liner to be used shall be

submitted in accordance with the submittals section.

The clear inside diameter of tunnel liners shall be within 4 inches of the nominal diameter indicated on the drawings.

2A-12.01. Tunnel Liner Plate. Steel liner plates shall be corrugated sections as manufactured by Armco or Commercial Shearing and Stamping Company. Liner plates shall have sectional properties conforming to Section 16.5 of AASHTO "Standard Specifications for Highway Bridges" or Section 4.12.5, Table 1, of AREA "Manual for Railway Engineering".

The liner plates shall be designed so that erection and assembly can be accomplished entirely from inside the tunnel. Liner plates shall be capable of withstanding the ring thrust load and transmitting this from plate to plate. Liner plates shall have a minimum thickness of 0.0747 inches.

All liner-plates shall be hot-dip galvanized in conformity with ASTM A123 for 2.50 ounce coating after the plates are formed or shaped. Bolts and nuts shall be hot-dip galvanized in conformity with ASTM A153.

Care shall be taken during installation to maintain alignment, grade, and the circular shape of the tunnel. Longitudinal joints in adjacent rings shall be staggered and not in alignment more often than every second ring.

The entire operation of tunneling and setting of liners shall be acceptable to the Owner and the agency having jurisdiction. Adequate means shall be provided to keep the work free from water.

Sufficient sections shall be provided with 1-1/2 inch or larger grouting holes, located near the centers, so that when the plates are installed there will be one line of holes on each side of the tunnel and one at the crown; the lower line of holes on each side shall be not more than 9 feet apart and shall be staggered.

All space between the lining and the earth shall be filled with grout forced in under pressure. The grout shall be mixed in the volumetric proportions of 2 parts portland cement, one part fly ash, and not to exceed 6 parts of sand. Enough water shall be used to produce, when well mixed, a grout having the consistency of thick cream. As the pumping through any hole is stopped, it shall be plugged to prevent backflow of grout.

Grouting shall be performed in a sequence which will preclude deflections exceeding 5 per cent of the tunnel diameter.

2A-12.02. Wood Skids. Wood skids shall be provided as indicated on the drawings. The wood shall be pressure treated with creosote, pentachlorophenol, or salt type preservative in accordance with AWPA C2. Cut surfaces shall be given two heavy brush coats of the same preservative.

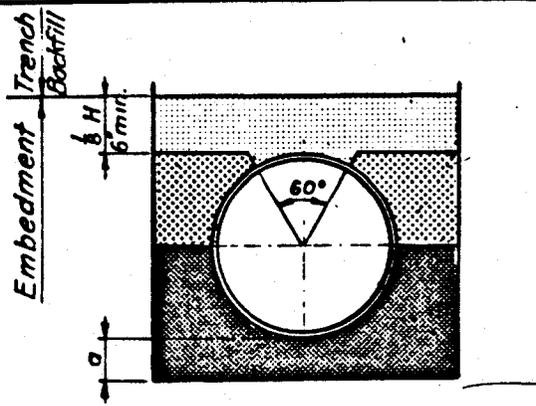
The wood skids shall be securely strapped to the cast iron pipe with steel strapping material at least 3/4 inch wide.

2A-12.03. End Closure. Both ends of each casing conduit shall be closed with 2 inch thick wood planks as indicated on the drawings. Planks shall be pressure treated with creosote, pentachlorophenol, or salt type preservative in accordance with AWWA C2. Cut surfaces shall be given two heavy coats of the same preservative. Nails and fasteners shall be galvanized or aluminum coated.

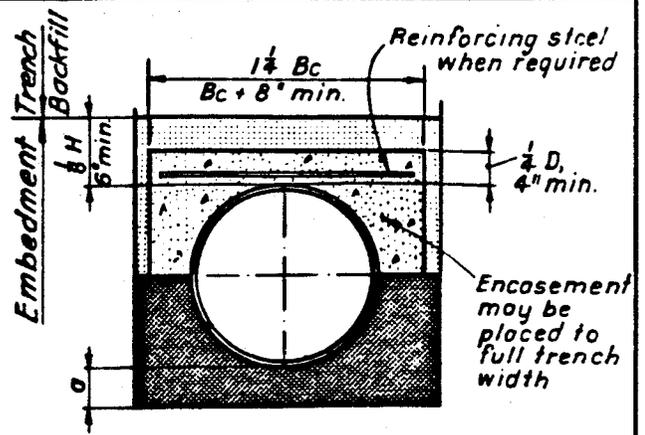
2A-12.04. Paved Invert. The bottom portion of each casing conduit constructed using either tunnel liner plates or corrugated steel pipe shall be provided with a paved concrete invert as indicated on the drawings.

2A-13. SETTLEMENT. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the warranty period stipulated in the Standard Specifications.

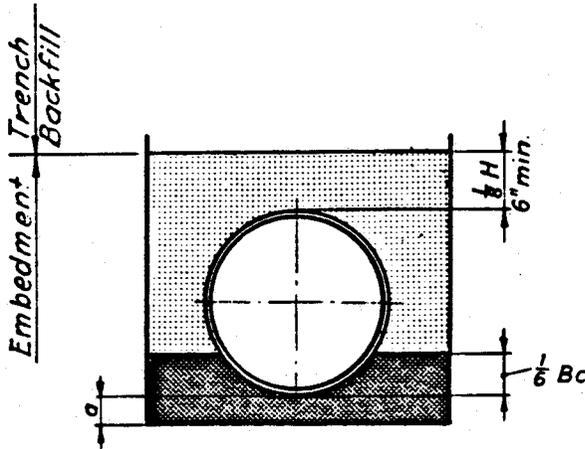
The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer.



CLASS B
FIRST CLASS BEDDING



CLASS A
ARCH ENCASEMENT



CLASS C
ORDINARY BEDDING

NOTES:

Granular embedment shall be crushed rock or pea gravel with not less than 95% passing $\frac{1}{2}$ " (95% passing $\frac{3}{4}$ " for 30" and larger pipe) and not less than 95% retained on a #4; to be placed in not more than 6" layers and compacted by slicing with a shovel or vibrating.

Compacted embedment shall be finely divided job excavated material free from debris, organic material, and stones, placed in uniform layers not more than 8" thick, and compacted to 95% maximum density as determined by ASTM D698; inundated sand; or graded gravel. Granular embedment may be substituted for all or part of compacted embedment.

Hand placed embedment shall be finely divided material free from debris and stones.

LEGEND

Bc Outside diameter of pipe

H Cover above top of pipe

D Nominal pipe size

a Embedment below pipe (See Table)

 Hand placed embedment

 Compacted embedment

 Granular embedment

 Concrete

TABLE OF EMBEDMENT
DEPTHS BELOW PIPE

\underline{D}	\underline{a} Min. Soil	\underline{a} Min. Rock
27" & smaller	3"	6"
30" to 60"	4"	9"
66" & larger	6"	12"

EMBEDMENTS FOR CONDUITS

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

FIGURE 1-2 A

Section 2B - PRETENSIONED CONCRETE CYLINDER PIPE

2B-1. SCOPE. This section covers circumferentially pretensioned reinforced concrete pressure pipe with a steel cylinder and rod reinforcement, and steel fittings lined and coated with concrete or mortar, to be provided for all 24 inch, 30 inch, and 36 inch piping. Blowoff and air release piping is covered in the cast iron pipe section.

Pressure and leakage tests, cleaning, disinfection, and cathodic protection are covered in other sections. Pipe trenching, bedding, and backfill are covered in the excavation and trenching section.

All straight pipe, bends, tees, adapters, access manholes, closure pieces, blowoff fittings, and other fittings or specials shall be furnished as indicated on the drawings or required to complete the work. All piping shall be installed complete with all jointing materials and accessories, anchors and blocking, and other necessary appurtenances.

2B-2. GOVERNING STANDARD. Except as modified or supplemented herein, the manufacture of pretensioned concrete cylinder pipe, fittings, and specials shall be governed by AWWA C303. The supplementary information required in the foreword of the governing standard is as follows:

Tabulated Layout Schedule (Sec. 1.5.2)	Required.
Identification Marks (Sec. 1.6)	Required.
Inspection (Sec. 1.7.1)	Not required.
Concrete Lining Quality Control Test Reports (Sec. 1.9.2)	Not required.
Steel Test Reports and Specimens (Sec. 1.9.3 and 1.9.4)	Not required.
Rubber Gasket Test Results (Sec. 1.9.5 and 2.8.8)	Not required.
Reinforcement Bar Weld Testing (Sec. 1.9.6)	Not required.
Affidavit of Compliance (Sec. 1.10)	Required.
Concrete Aggregate Samples (Sec. 2.2.3)	Not required.
Design Calculations (Sec. 3.2.1)	Required.
Welding Details (Sec. 3.5.2)	Not required.
Specials and Fittings (Sec. 4.1)	As specified herein.

2B-3. MATERIALS. Unless otherwise specified, all materials used in the manufacture of pipe, fittings, and accessories shall conform to AWWA C303.

Fine Aggregate

Clean sand, ASTM C33.

Joint Ring Gaskets

AWWA C303, Sections 2.8 and 3.4, except polymer shall be synthetic rubber. Natural rubber will not be acceptable.

Joint Diapers

24 Inch Pipe and Smaller

Fabric with steel strap in hems, at least 6 inches wide.

27 Inch Pipe and Larger

Fabric with steel strap in hems, at least 7 inches wide.

Flanged Joints

Flanges

AWWA C207, except where otherwise permitted or required.

Diameter, Drilling,
or Thickness

AWWA C207, Class D.

Blind Flanges

Same as pipe flanges to which they attach except thickness shall be as indicated on the drawings or specified.

Flange Bolting

Material

ASTM A307.

Type

Bolt and nut; bolt-stud and two nuts permitted for one inch and larger.

Bolts and Bolt-Studs

Length

Such that ends project 1/4 to 1/2 inch beyond surface of nuts.

Ends

Chamfered or rounded.

Threading

ANSI B1.1, coarse thread series, Class 2A fit. Bolt-studs may be threaded full length. Studs for tapped holes shall be threaded to match threading in holes.

Bolt Heads

Dimensions	ANSI B18.2.1; regular pattern for square, heavy pattern for hexagonal.
Nuts	Hexagonal.
Dimensions	ANSI B18.2.2, heavy, semifinished pattern.
Threading	ANSI B1.1, coarse thread series, Class 2B fit.
Gaskets	AWWA C207, ring type; Crane Packing Company "Style 777 - Cloth Inserted Synthetic Rubber Sheet Packing" or "Style 2150 - Medium Duty Asbestos Sheet Packing"; or Garlock "Style 19 Cloth-Inserted Rubber Sheet Gasketing" or "Style 900 Compressed Asbestos Sheet Gasketing".
Gasket Compound	Garlock "Compound No. 101-S" or Tite Seal "T25".
Mechanical Couplings	
Reducing	Dresser "Style 62", Rockwell/Smith-Blair "413" and "415", or Baker "Series 220"; without pipe stop.
All others	Dresser "Style 38", Rockwell/Smith-Blair "411 Flexible Coupling", or Baker "Series 200"; without pipe stop.
Harnessed Restrained Joints	
Bolts	ASTM A193, Grade B7.
Threading	ANSI B1.1, Class 2A fit, coarse thread series for one inch and smaller and 8-thread series for 1-1/8 inch and larger.
Ends	Chamfered or rounded.

Nuts	Hexagonal, ASTM A194, Grade 2H or better.
Threading	As specified for bolts except Class 2B fit.
Dimensions	ANSI B18.2.2, heavy, semifinished pattern.
Washers	Hardened steel, ASTM A325.
Mechanical Joints	AWWA C111.
Threaded Connections	ANSI B2.1, NPT.
Modular Casing Seals	Thunderline Corporation "Link-Seal Type LS-400M" modular wall and casing seals; number of links as required for special circumferential seals.
Coatings	
Rust Inhibitive Primer (Universal type)	Cook "391-R-259 Clorocon Barrier Coat", Koppers "No. 10 Inhibitive Primer", Mobil "13-R-50 Chromox Q.D. Primer", Tnemec "77 Chem-Prime", Amercoat "5101", or Rust-Oleum "769".
Rust Preventive Compound	Houghton "Rust Veto 344" or Rust-Oleum "R-9".
Coal Tar Primer	Koppers "Bitumastic Mill Undercoat" or Mobil "35-J-6 Bituminous Black".
Medium Consistency Coal Tar Paint	Koppers "Bitumastic Super Service Black", Mobil "35-J-10 High-Build Bituminous Coating", or Tnemec "46-449 Heavy Duty Black".
Thixotropic Coal Tar	MIL-C-18480, Koppers "Bitumastic No. 50", Mobil "35-J-10 High-Build Bituminous Coating", or Tnemec "46-450 Heavy Tnemecol".
Coal Tar Epoxy	AWWA C210.

2B-4. BASIS OF DESIGN. Except as modified herein, pipe and fittings shall be designed in accordance with Appendix A of the governing standard to withstand the following external loadings and internal pressures:

<u>Pipe</u>		<u>External Load</u> (pounds per lin ft)	<u>Working</u>	<u>Working +</u>
<u>Size</u> (in.)	<u>Class*</u>		<u>Pressure</u> (psi)	<u>Surge Pressure</u> (psi)
30	I	5,050	70	150
	II	8,500		
36	I	5,200	90	150
	II	6,300		
	III	8,200		
24	I	7,100	90	150

*All pipe shall be class I unless otherwise indicated on the drawings.

Design of the pipe for external loadings shall be based on the following values:

Modulus of soil reaction (E')	1,000 psi
Bedding constant (K)	0.090
Deflection lag factor (D1)	1.25

2B-5. FITTINGS. Fittings shall comply with Section 4 of AWWA C303. Fittings shall be designed for the same external loads and internal pressures as the adjacent pipe.

2B-6. AIR RELEASE AND BLOWOFF ASSEMBLIES. Each blowoff and air release shall be arranged to provide a horizontal flanged connection as indicated on the drawings. One of the following arrangements shall be employed:

- a. Tangential flanged outlets.
- b. Radial flanged outlets, plus a flanged cast iron or cast steel bend for each.

2B-7. ADAPTERS. Adapters shall be furnished in the locations where required for connection to other types of pipe. The spigot or bell shall be welded to the cylinder for the concrete portion of the adapter. Spigots shall have a wall thickness of at least 1/4 inch, shall have a concrete lining at least 3/8 inch thick, and shall be at least 2 feet long.

2B-8. RESTRAINED JOINTS. Where indicated on the drawings, joints shall be restrained by clamps, bolts, retaining rings, bolt harness assemblies, or other method acceptable to the Engineer. Joints may be restrained by welding, provided the welded joint is designed to develop the full strength of the longitudinal steel in the pipe barrel, which shall be designed to resist the longitudinal thrust.

Design of harness bolts, if used, shall be based on a maximum stress of 40,000 psi over the tensile stress area of the bolt.

Each restrained joint pipe shall be designed to resist thrust of the magnitude indicated on the drawings, resulting from application of the specified hydrostatic test pressure. The length of pipe having restrained joints shall be as indicated on the drawings. The longitudinal thrust shall be assumed to vary uniformly from a maximum at the bend or dead end to zero at the end of the required length of restrained joint piping. Restrained joints and pipe cylinders shall be designed to withstand the calculated stresses at all points along the length of pipe having restrained joints. The maximum longitudinal stress in pipe cylinders shall not exceed 16,000 psi.

Except when welding is used to provide restraint, when angular deflection is required at restrained bell and spigot joints, shall be provided with special bevels for the exact angle. Deflection obtained by opening joints on one side will not be acceptable.

2B-9. REDUCERS. Tapered reducers shall be provided at the locations indicated on the drawings. Reducers shall have a diametral reduction of not more than 3 inches per foot of length.

2B-10. FLANGED JOINTS. Flange faces shall be normal to the pipe axis, and angular deflection (or layback) of the flange face shall not be excessive. All flanges, after welding to the pipe, shall be refaced, if necessary, to prevent distortion of connecting valve bodies from excessive flange bolt tightening or any leakage at the joint.

Pipe lengths and dimensions and drillings of flanges furnished shall be coordinated with the lengths and flanges for the valves, fittings, and other items to be installed in the piping. All mating flanges shall have the same diameter and drilling and shall be suitable for the pressures to which they will be subjected.

Blind flanges shall conform in diameter and drilling to the flanges to which they attach. Thickness of blind flanges shall be as indicated on the drawings or as required to produce a watertight joint under the specified test pressure. Details of blind flanges shall be acceptable to the Engineer.

Welding-neck or slip-on flanges welded to short lengths of pipe shall be used where installation of flanges in the field is permitted or required.

2B-11. MECHANICAL COUPLINGS. The middle ring of each mechanical coupling shall have a thickness at least equal to that specified for the adapter on which the coupling is to be used and shall not be less than 10 inches long for pipe 36 inches and larger and not less than 7 inches long for pipe under 36 inches in diameter.

The interior surfaces of middle rings shall be prepared for painting in accordance with instructions of the paint manufacturer and then coated with coal tar epoxy in accordance with AWWA C210. The remaining components shall be cleaned and shop primed with rust inhibitive primer.

2B-12. MARKING. Each pipe, fitting, or special section shall have plainly and permanently marked thereon:

Pipe class.

Date of manufacture.

Manufacturer's name or trademark.

On bends, the angle turned.

Identification of specials to show proper location in line.

On beveled pipe, amount of bevel and point of maximum bevel, marked on the beveled end.

Markings shall be indented in the pipe or painted thereon with waterproof paint.

Each end of each bevel end pipe, fitting, or special shall be marked with a stripe of paint, approximately 1-1/2 inches wide and 2 feet long, applied along the top centerline.

2B-13. HANDLING. Concrete pipe and fittings shall be handled carefully and shall not be bumped or dropped. Hooks shall not be permitted to come in contact with joint surfaces.

2B-14. LAYING PIPE. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in the excavation and trenching section. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench

conditions. Pipe shall be laid with bell ends facing the direction of laying except when reverse laying is specifically permitted by the Engineer.

Foreign matter shall be prevented from entering the pipe during installation.

Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water in the trench shall be removed prior to removing the plug.

2B-14.01. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.

2B-14.02. Alignment. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Curves may be formed by using fittings or beveled joints or by opening the joints.

2B-14.03. Joint Opening. The minimum reserve extensibility (distance from the near edge of the spigot groove to the edge of the flare of the bell) remaining after joints are deflected shall be not less than the amount indicated on Figure 1-2B at the end of this section. For bells having a depth of straight portion different from that indicated on the drawing and for spigots having sealing and gasket retention space different from that indicated on the drawings, the maximum joint opening shall be correspondingly adjusted.

2B-15. JOINTING.

2B-15.01. Bell and Spigot Joints. Rubber and steel bell and spigot joints shall be installed in accordance with the pipe manufacturer's recommendations. Immediately before the pipe is jointed, all exterior spigot and interior bell surfaces shall be thoroughly cleaned and well lubricated with a vegetable soap. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. The rubber gasket shall then be stretched over the spigot and settled into the spigot groove, and the pipe pushed or pulled into final position.

The position and condition of the rubber gasket shall be checked before the next piping unit is installed. When jointing 24 inch or larger concrete pipe, steel inserts shall be used to prevent the pipe from entering to the full depth of the bell until the position of the gasket has been checked.

Joint space outside the rubber gasket shall be filled with grout. A diaper shall be placed around the outside of the joint to prevent entrance of earth into the joint space before grouting and to serve as a form for the grout.

Grout shall be composed of one part portland cement and 2 parts sand, mixed to a pouring consistency and constantly stirred while being poured to prevent segregation. Sand for grout shall be clean masonry sand passing a 16 mesh sieve. Grout shall be poured between the diaper and the pipe and allowed to run down around to the bottom of the pipe. The grout shall be rodded, while being poured, with a stiff wire curved to the approximate radius of the pipe. The joint recess shall be completely filled at all points.

Not less than two lengths of pipe shall be in final position in advance of joint grouting. If pipe embedment operations are resumed before the grout has attained initial set, extreme care shall be taken to prevent damage to the grout while placing and compacting embedment material.

After trench backfilling operations over the pipe have been completed, the inside joint recess of all 24 inch or larger concrete pipe shall be filled with stiff mortar mixed in proportions of one part portland cement to 2 parts masonry sand passing a 16 mesh sieve. Joint surfaces shall be damp, but free from surface water when the mortar is placed. Mortar shall be thoroughly compacted and finished smooth. All excess mortar shall be removed from the pipe.

2B-15.02. Flanged Joints. Care shall be taken in bolting flanged joints so that there is no restraint on the opposite end of the piece which would prevent pressure from being evenly and uniformly applied upon the gasket. The pipe or fitting must be free to move in any direction while bolting. Bolts shall be gradually tightened, each in turn, at a uniform rate of gasket compression around the entire flange.

2B-15.03. Couplings. The ends of the pipe on which couplings are to be placed, and the couplings themselves, shall be clean and free from any dirt or foreign material, especially those surfaces of the pipe and coupling that come in contact with the gaskets. Gaskets shall be kept clean with no foreign matter between them and the packing surfaces. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. All bolts shall be tightened approximately the same amount with all parts of the couplings square and symmetrical with the pipe. After installation, couplings shall be carefully touched up or reprimed.

2B-15.04. Mechanical Joints. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If

effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Overtightening bolts to compensate for poor installation practice will not be permitted.

2B-16. CONNECTIONS WITH EXISTING LINES. Where connections are made between new work and existing piping, such connections shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at the time and under conditions which will least interfere with service to customers affected thereby, and as authorized by the Owner. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

2B-17. CONCRETE ENCASEMENT AND BLOCKING. Concrete encasement and blocking shall be installed where and as indicated on the drawings. Concrete and reinforcing steel shall be as specified in the cast-in-place concrete section. All pipe to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation. Blocking shall bear against undisturbed earth. Minimum bearing area shall be as indicated on the drawings.

2B-18. PROTECTIVE COATINGS. Unless otherwise specified, metal surfaces shall be protected as specified herein.

2B-18.01. Shop Coatings. Bolts, flange faces, and steel joint rings shall be shop coated with rust preventive compound as specified. All other metal surfaces shall be shop primed with coal tar primer as specified.

At the option of the Contractor, in lieu of shop coating with rust preventive compound, all surfaces of steel joint rings exposed in finished pipe shall be protected from corrosion by means of a coating of metallic zinc not less than 0.002 inch thick applied by the metalizing process.

2B-18.02. Surfaces Exposed Underground. All metal surfaces which will be in contact with backfill after installation and are not encased in concrete or cement mortar coating shall be cleaned to remove all rust and foreign materials, primed, and wrapped with two half-lapped layers of tape field wrapping, or coated with 35 mils of thixotropic coal tar coating. Field wrapping shall be applied in accordance with the manufacturer's recommendations.

Backfill adjacent to wrapped surfaces shall consist of clean sand or pea gravel.

2B-18.03. Surfaces Exposed in Manholes. All metal surfaces exposed inside manholes after installation shall be cleaned and given two

coats of medium consistency coal tar paint.

2B-19. HYDROSTATIC TESTS. After installation, pretensioned concrete cylinder piping shall be tested for defective workmanship and materials by being subjected to a hydrostatic test as specified in the pressure and leakage tests section of the Standard Specifications.

2B-20. LEAKAGE. All pretensioned concrete cylinder piping shall be watertight and free from leaks. Leakage tests will be as specified in the pressure and leakage section of the Standard Specifications. Each leak which is discovered within the correction period stipulated in the Standard Specifications shall be repaired by and at the expense of the Contractor.

2B-21. CLEANING AND DISINFECTION. After installation, pretensioned concrete cylinder piping shall be cleaned and disinfected as specified in the disinfection section.

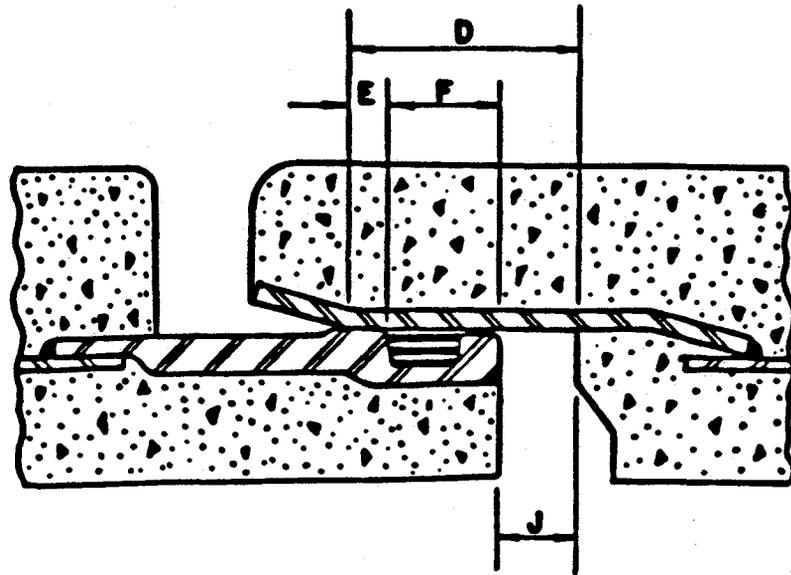
2B-22. DRAWINGS AND DATA. Drawings, specifications, installation schedules, and other data showing complete details of the design, fabrication, construction, field locations and elevations, and installation of pipe, fittings, specials, and connections, together with complete data covering all materials proposed for use, shall be submitted in accordance with the submittals section. The drawings and data shall include but shall not be limited to the following for each size and class of pipe.

Pipe design.

Details of fittings and specials.

Test reports.

Laying schedule.



- D = Depth of straight portion of bell
- E = Minimum reserve extensibility
- F = Sealing and gasket retention space
- J = Maximum joint opening

Pipe Size	D	E		F	J		
		Layout	Installed		Layout	Installed	
<i>(all dimensions are in inches)</i>							
10-21	2-1/2	3/4	5/8	1-1/8	5/8	3/4	
24-42	2-3/4	3/8	3/8	1-1/8	1-1/4	1-1/4	

MAXIMUM JOINT OPENING FOR DEFLECTED RUBBER AND STEEL JOINTS

Black & Veatch
Engineers - Architects
Kansas City, Missouri

**PRETENSIONED CONCRETE
CYLINDER PIPE**

FIGURE 1-2.B

Section 2C - DISINFECTION

2C-1. SCOPE. This section covers disinfection of the transmission main and appurtenant piping.

2C-2. GENERAL. Hydrostatic and leakage testing of pipelines in accordance with the Standard Specifications shall be completed prior to cleaning and disinfection.

Water required for testing, cleaning and disinfection will be furnished as stipulated in the special provisions and standard specifications.

Water used for testing, cleaning and disinfection shall be wasted and disposed of in a manner satisfactory to the Engineer and shall not be allowed to enter other parts of the system.

2C-3. PIPELINE CLEANING. The transmission main, including all valves and fittings installed therein, shall be flushed or cleaned to the satisfaction of the Engineer.

Small pipelines shall be flushed with water at the maximum velocity which can be developed. The flushing velocity shall be at least 2 feet per second, unless otherwise permitted by the Engineer. Flushing shall be accomplished through the installed valves or fittings, or through corporation cocks furnished and installed for that purpose.

Large pipelines shall be flushed as specified above, or may be cleaned with a hose or by other methods acceptable to the Engineer.

Booster pumps shall be used if required to obtain the necessary velocity of water.

2C-4. DISINFECTION. All disinfection work shall be acceptable to the Arizona State Department of Health, and any and all requirements thereof which may be in conflict with the provisions of this specification shall govern.

The required disinfection work shall be performed by a subcontractor specializing in such work, or with the permission of the Engineer, the Contractor may provide the necessary equipment and do the work with his own employees. In either case, all work shall be done under the direct superintendence and authority of a competent and experienced specialist in such work.

The Contractor shall provide acceptable means for taking samples to check chlorine residual. Chlorine residual tests will be made by the Owner.

Prior to starting any disinfection work, the Contractor shall submit to the Engineer a detailed outline of the procedures proposed, the coordination and sequence of operations, manner of filling and flushing disinfected lines, and the disposal of wasted water. All procedures shall be acceptable to the Engineer.

2C-4.01. Pipeline Disinfection. After the completion of cleaning the transmission main shall be disinfected in accordance with the requirements of AWWA C601.

During disinfection, all valves shall be operated to ensure that all appurtenances are disinfected. Valves shall be manipulated in such a manner that the strong chlorine solution in the line being chlorinated will not flow back into the supply line. Check valves may be used if desired.

Following chlorination, all treated water shall be flushed from the entire length between extremities of each line until the replacement water throughout its entire length, on test, is satisfactory.

Should the initial treatment fail to produce the required residual content, the original chlorination procedure shall be repeated until satisfactory results are obtained.

Section 2D - CORROSION PROTECTION

2D-1. GENERAL. A metering system shall be installed for determining the need for cathodic protection. The metering system shall include the bonding of all joints and the installation of test lead stations, as shown on Figures 1-2D and 2-2D.

Test lead stations shall be provided at the locations shown on the drawings.

2D-2. TESTING. The Contractor shall provide a certified report verifying electrical continuity and dielectric isolation of the buried pipelines. The buried pipelines shall be tested for electrical continuity and dielectric isolation from other structures after all connections have been made. The testing procedure shall be as follows:

1. The test shall be conducted by measuring response of the pipe to the application of cathodic protection test current with an auxiliary ground at a minimum of ten (10) feet from pipeline. The positive terminal of the portable test rectifier unit shall be connected to the auxiliary ground. The negative terminal shall be connected to the pipeline at a test station. The test rectifier shall be energized with AC power and shall be adjusted to provide sufficient DC current to obtain adequate pipe-to-soil potential shifts along the pipeline from performing the test. A set of "NATIVE" potentials shall be obtained prior to the applications of the test current.
2. Measurements of pipe-to-soil potential shall be made with the test current turned both off and on. The pipe-to-soil potential shall be measured at representative locations along the full length of the pipeline to be tested. In addition, potential measurements shall be taken across potentiometer/voltmeter circuit of a multi-combination meter and with respect to a portable copper sulfate reference electrode placed at grade. Contact to the pipe for obtaining potential measurements shall be made at test stations previously installed during construction for that purpose.
3. If the pipe-to-soil potential is made more positive by application of the test current, electrical discontinuity of the pipeline is indicated between that point and the point at which the test rectifier negative connection was made.
4. If the pipe-to-soil potential is made more negative by application of the test current, electrical continuity of

the pipeline is indicated between that point and the point at which the test rectifier negative connection was made. The magnitude of negative shifts will be analyzed to determine if the degree of electrical continuity is consistent with the specified requirements for joint bonding.

5. Dielectric isolation across insulating fittings shall be indicated by the pipe-to-soil being more positive or in significant differences in the pipe-to-soil potentials across the fittings with the application of the test current.
6. Multiple test setups will be necessary so that the full length of the pipeline is demonstrated to be electrically continuous and dielectrically isolated from other structures.

2D-3. PAYMENT. The installation and testing of this system is a no pay item, and all costs should be included in the Bid Items for pipe installation.

2D-4. DRAWINGS AND DATA. Drawings and data covering the metering system shall be submitted together with the piping submittal in accordance with the submittals section.

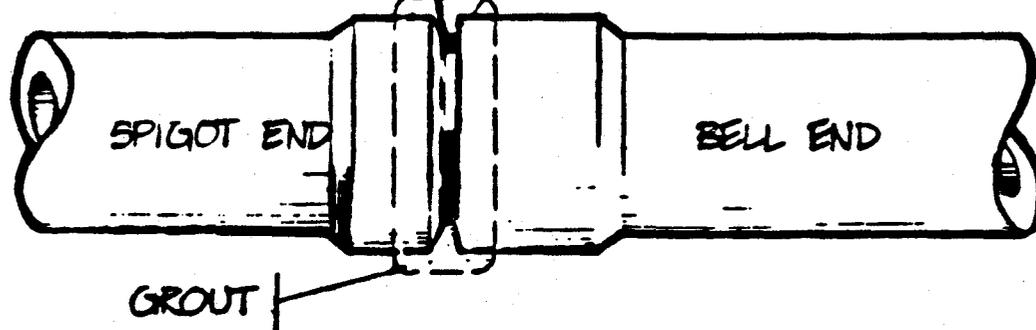
NEW OR EXISTING
VALVE BOX &
COVER

COIL WIRE IN WATER VALVE
HOUSING, WHERE INDICATED
ON PLANS. PROVIDE SUFFICIENT
LENGTH TO EXTEND @ LEAST
3' ABOVE BOX COVER FOR
TESTING (USE ADJACENT VALVE
BOX WHERE POSSIBLE, OR
INSTALL NEW HOUSING PER
DETAIL 301-1-C.)*

* INSTALL SKIRTED LID
SECTION ONLY, WHERE
CONDUCTOR IS NOT
BROUGHT UP AT ACTUAL
VALVE LOCATION.

NO. 8 CONDUCTOR
(TW. COPPER WIRE)

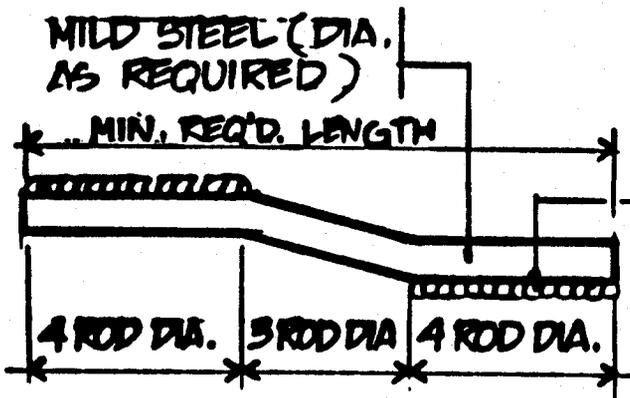
ATTACH TO THE SPIGOT END
OF A JOINT BY 1" THERMITE
CADWELD¹ PRIOR TO PLACE-
MENT OF OUTSIDE GROUT.



TEST LEAD STATION (CATHODIC PROTECTION)

... REQUIRED IF EITHER OF THE FOLLOWING PIPE TYPES IS
INSTALLED:

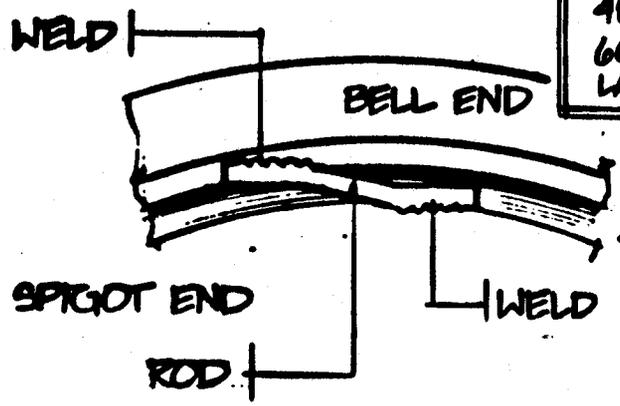
- 1.) CEMENT-MORTAR LINED & REINF. CEMENT
MORTAR COATED STEEL PIPE (S.C.P.).
- 2.) PRETENSIONED, REINF. CONCRETE WATER
PIPE, STEEL CYLINDER TYPE; (L.C.P.).



Rod Detail

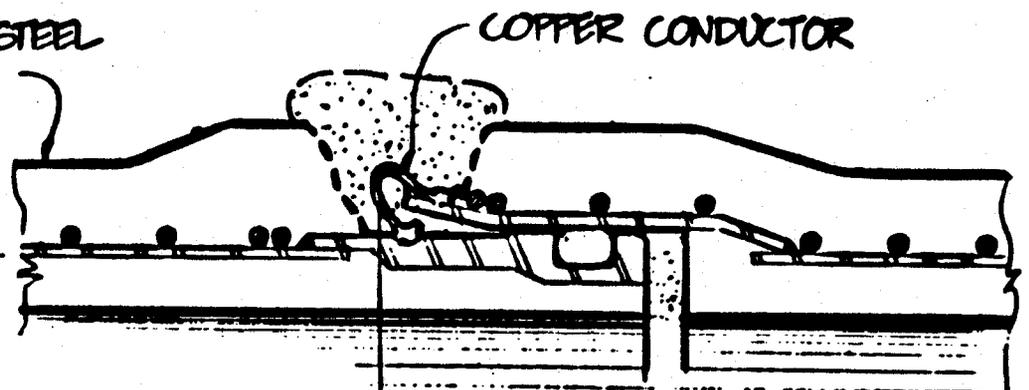
PIPE DIA.	QUAN. EA.	ROD DIA.	CONDUCTOR
10" - 18"	1	3/8"	#4 AWG.
20" - 33"	1	1/2"	#4 AWG.
36" - 45"	1	5/8"	#2 AWG.
48" - 57"	2*	1/2"	#2 AWG.
60" AND LARGER	2*	5/8"	#1/0 AWG.

* ONE ON EACH SIDE OF SPRINGLINE



Rod Attachment Detail

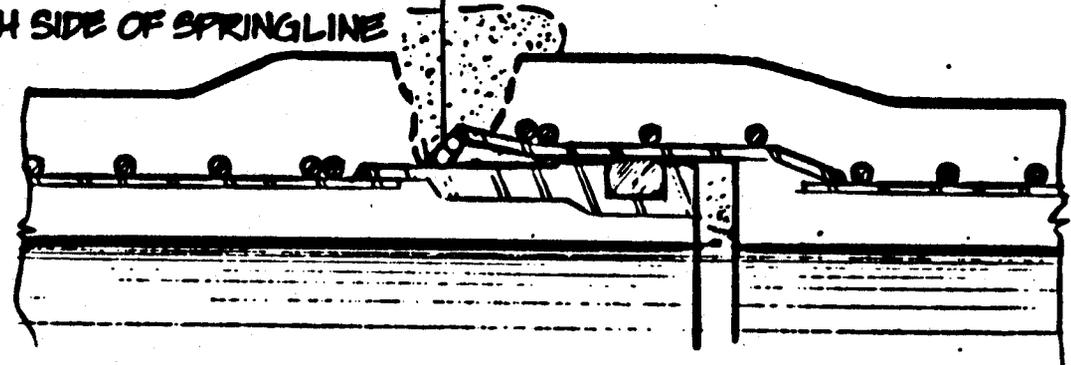
CONC. OR STEEL CYL. PIPE



Alternate Method

COPPER CONDUCTOR ATTACHED TO BELL @ MANUFACTURE & ATTACHED TO SPIGOT @ ASSEMBLY - THERMITE CADWELD

ROD: SEE ROD WELDING DETAIL LEFT.



Pipe Sections

CATHODIC PROTECTION BONDING DETAILS

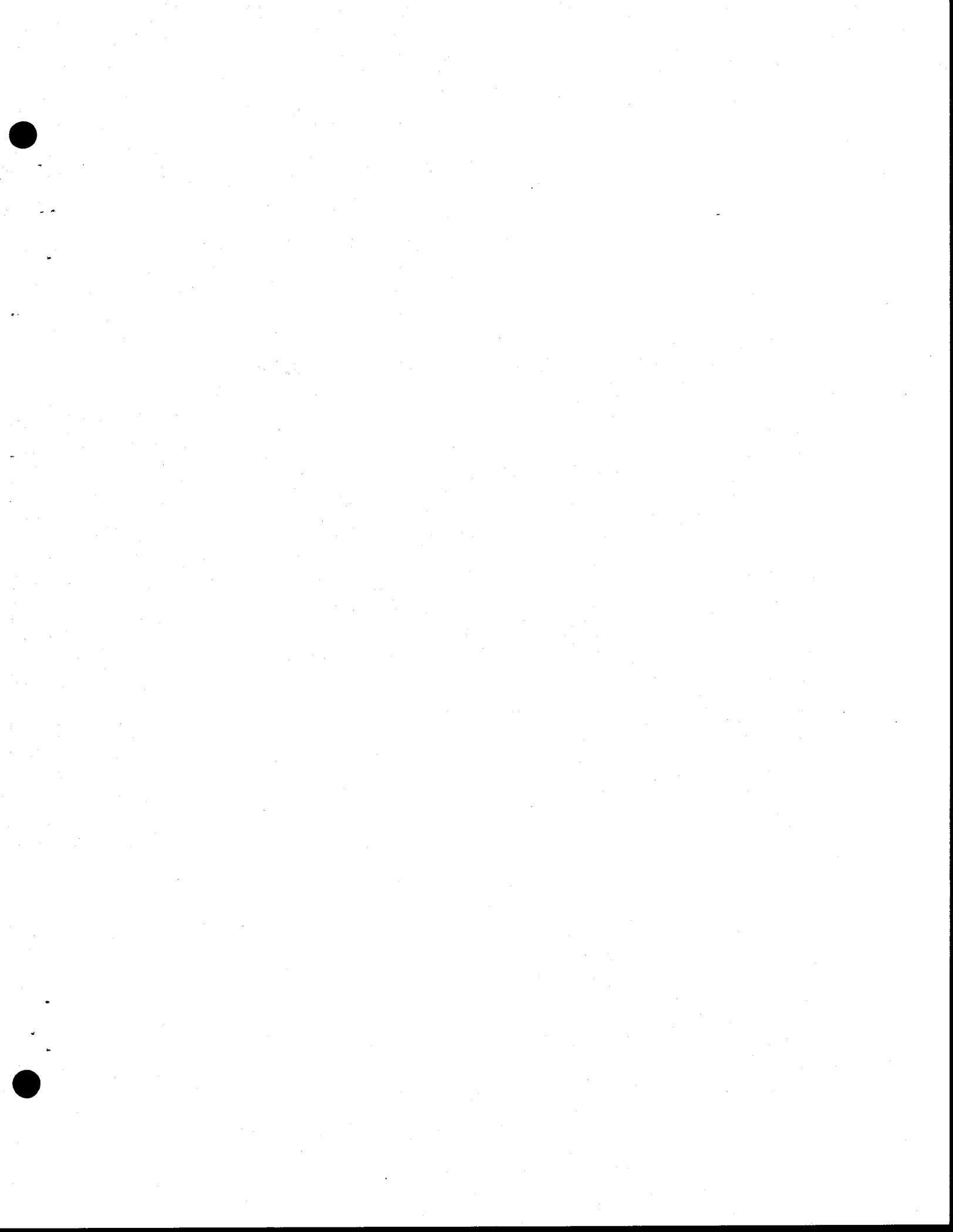
Section 3A - CONCRETE

3A-1. SCOPE. All cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work shall conform to the Standard Specifications except as modified herein. All concrete will be Class AA.

3A-2. MATEREALS.

Reinforcing Steel
Bars

ASTM A615 (and Supplement SI),
deformed, Grade 60.



Section 7A - CONCRETE DAMPPROOFING

7A-1. SCOPE. This section covers paint-type dampproofing of concrete.

7A-2. MATERIALS. Materials to be used shall be as follows:

Coal Tar Coating

Koppers "Bitumastic Super Service Black", Polyguard "CA-14 Coating", or Tnemec "46-449 Heavy Duty Black".

7A-3. SURFACES TO BE DAMPPROOFED. Exterior wall surfaces which are poured against sheeting or undisturbed earth need not be dampproofed. The following concrete surfaces shall be dampproofed with coal tar coating:

All exterior concrete wall surfaces forming a part of an interior room or dry pit which will be in contact with earth backfill below finished grade and above the top of the footings or bottom slabs.

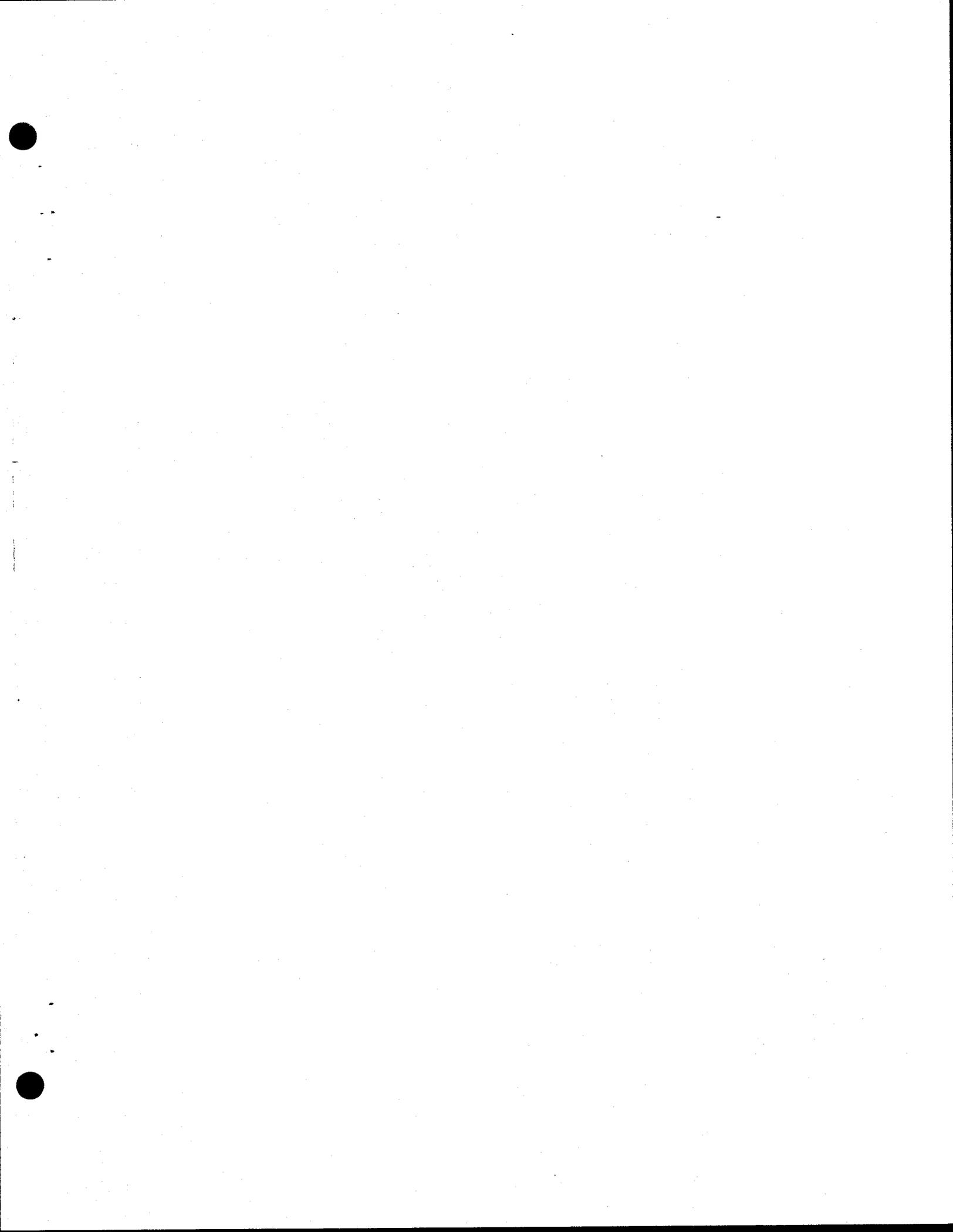
7A-4. SURFACE PREPARATION. When dampproofing is applied, concrete surfaces shall be clean and dry. All dirt, dust, sand, grit, mud, oil, grease, and other foreign matter shall be removed and the surface prepared as recommended by the manufacturer of the dampproofing material. Oil and grease shall be removed by use of solvents before mechanical cleaning is started.

7A-5. APPLICATION. Dampproofing materials shall not be thinned unless recommended by the manufacturer. Coal tar coating shall be applied in at least two coats, with a total dry film thickness of at least 20 mils.

Surfaces not intended to be dampproofed shall be adequately protected from contamination, discoloration, or other damage. Surfaces shall be masked as necessary to protect uncoated areas and to terminate dampproofing at the intended limits.

Dampproofing shall be applied by high pile rollers or spray equipment complying with the manufacturer's recommendations. In the event of blistering of the first coat or coats, all blisters larger than one-quarter inch diameter shall be broken before the subsequent coat is applied.

Surfaces shall be dry and at recommended temperature when dampproofing is applied. Unless properly protected, coatings shall not be applied in wet, damp, or foggy weather or when windblown dust, dirt, or debris, or insects will collect on the coating. Dampproofing shall not be applied when the temperature of the air or the surface is below 50 F.



Section 9A - PAINTING

9A-1. SCOPE. This section covers field painting, including surface preparation, protection of surfaces, and other appurtenant work. Regardless of the number of paint coats previously applied, at least two field coats of paint shall be applied to all surfaces unless otherwise specified.

Dampproofing of concrete surfaces is covered in other sections.

9A-2. MATERIALS. All paint shall be delivered to the job in original unopened containers with labels intact. Paint shall be stored inside and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the paint formulation shall be added to the paint for any purpose.

It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products which will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.

Where painting materials are referenced to Federal or Military Specifications, the reference shall define general type and quality required but is not intended to limit acceptable materials to an exact formulation.

9A-2.01. Primers and Pretreatments.

Rust Inhibitive

Universal type; Cook "391-N-142 Barrier Primer", Koppers "No. 10 Inhibitive Primer", Mobil "13- R- 28 Chromox Primer", or Tnemec "77 Chem-Prime".

Coal Tar

Koppers "Bitumastic Mill Undercoat" or Mobil "35-J-6 Bituminous Black".

9A-2.02. Intermediate and Finish Paints.

Gloss Alkyd Enamel

Fed Spec TT-E-489, Class A; Cook "801 Series Gloss Enamel", Koppers "Glamortex 501 Enamel", Mobil "12 Series Panorama Coatings", or Tnemec "Series 2 Tneme-Gloss".

Medium Consistency
Coal Tar

Koppers "Bitumastic Super
Service Black", Mobil "High-
Build Bituminous Coating
35-J-10", or Tnemec "46-449
Heavy Duty Black".

Thixotropic Coal Tar

MIL-C-18480; Koppers "Bitumastic
No. 50" or Tnemec "46-450
Heavy Tnemecol".

9A-3. PRODUCT AND COLOR SELECTION. The Contractor shall submit color cards for all paints proposed for use, together with complete descriptive specifications covering all unlisted brands, to the Consulting Engineer for review and color selection. Requests for review submitted directly to the Consulting Engineer by paint suppliers will not be considered.

9A-4. FIELD PRIMING. In general, surfaces of equipment, steel, and cast iron are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Shop coatings which are damaged or have failed, and have been determined unsuitable by the Engineer, shall be removed and the surfaces field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

<u>Surface to be Primed</u>	<u>Material</u>
Equipment, surfaces to be painted with	
Gloss alkyd enamel	Rust inhibitive
Coal tar paint	Coal tar, or the same as finish coats

9A-5.01. PAINTING SCHEDULE. The following schedule lists paints for intermediate and finish coats for surfaces to be painted. All exposed surfaces, including sides and edges, shall be painted.

<u>Surface to be Painted</u>	<u>Material</u>
9A-5.01. <u>Metal Surfaces.</u>	
Fire Hydrants	Gloss alkyd enamel
All metal surfaces, unless otherwise specified, which will be buried, all or in part, including valves, valve boxes, and supports below grade.	Medium consistency coal tar

All metal harness anchorage for buried piping.

Thixotropic coal tar

All exterior surfaces of cast iron and steel piping exposed in manholes, including valves, fittings, flanges, bolts, supports, and accessories.

Medium consistency coal tar

Valve handwheels

Gloss alkyd enamel

Miscellaneous castings, including manhole rings and covers, and manhole steps. (One coat, if not foundry dipped.)

Medium consistency coal tar

9A-6. MIXING AND THINNING. Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.

Paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below the thickness recommended by the paint manufacturer.

9A-7. SURFACE PREPARATION. All surfaces to be painted shall be dry and free of dirt, dust, sand, grit, mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of top coats.

Surfaces shall be free of cracks, pits, projections, or other imperfections which would prevent the formation of a smooth, unbroken paint film.

9A-7.01. Ferrous Metal Surfaces. Ungalvanized ferrous metal surfaces shall be cleaned for painting by means of solvents, high-speed power wire brushing, scraping, or other suitable methods. Surfaces of welds shall be given special treatment by scraping and wire brushing as necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

No dust is permitted to settle on adjacent wet paint films.

9A-8. APPLICATION. Paint shall be applied in a neat manner, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be hard and dry through the entire paint film before the next coat is applied. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness. In no case shall paint be applied at a rate of coverage which is greater than the maximum rate recommended by the manufacturer.

Paint showing sags, checks, blisters, teardrops, or fat edges will not be accepted and shall be entirely removed and the surface repainted.

9A-8.01. Priming. Edges, corners, crevices, welds, and bolts shall be given a brush coat of primer before the specified spot or touch-up painting of metal surfaces. Special attention shall be given to filling all crevices with paint.

9A-8.02. Film Thickness. The total paint film thickness including prime coat (if any), intermediate coats, and finish coat shall not be less than:

<u>Type of Paint</u>	<u>Minimum Dry Film Thickness</u>
Coal tar	
Medium consistency	20 mils
Thixotropic	35 mils
Gloss alkyd enamel	5 mils

9A-8.03. Weather Conditions. Paint shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied paint. Paint shall not be applied at an air temperature below 50 F, or to surfaces of metals, such as the surfaces of a tank or pipe containing cold water, which have a temperature below 50 F, regardless of the air temperature, or when metal temperature and atmospheric conditions cause condensation on the surface of the metal.

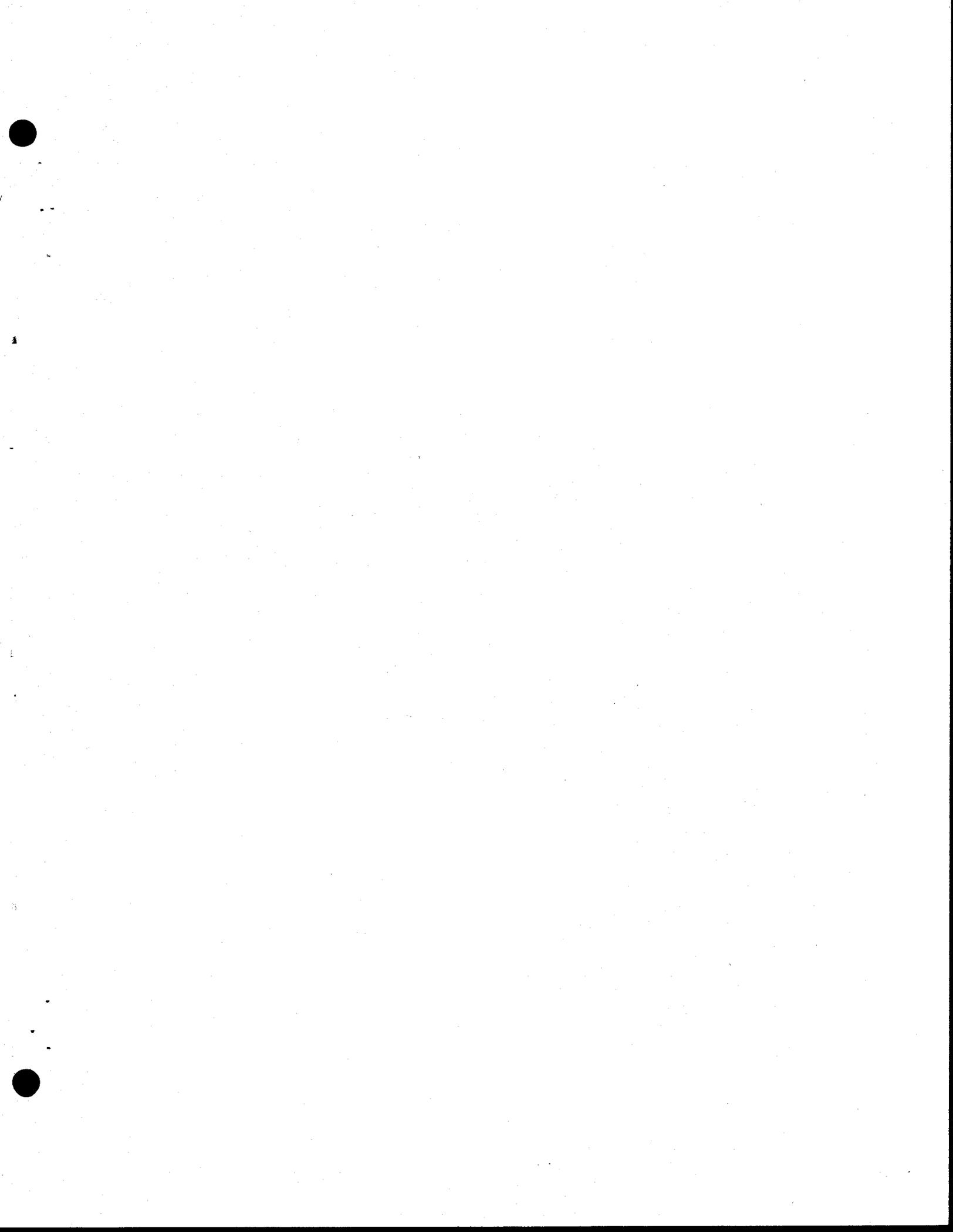
9A-9. REPAIRING FACTORY FINISHED SURFACES. Factory finished surfaces which have become damaged prior to acceptance by the Owner shall be spot primed and repainted with materials equivalent to those used in the original application.

9A-11. PROTECTION OF SURFACES. Throughout the work the Contractor shall use drop cloths, masking tapes, and other suitable measures to protect all surfaces from accidental spraying, spattering, or spilling

of paint. The Contractor shall be responsible for and shall correct and repair damage resulting from his operations or the operations of those responsible to him. Paint deposited on surfaces which are not being painted at the time shall be immediately removed. Exposed concrete or masonry not specified to be painted which is damaged by paint shall be either removed and rebuilt or, where authorized by the Owner, painted with two coats of masonry paint.

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9A-5



Section 13A - INSTRUMENTATION AND METERING EQUIPMENT

13A-1. SCOPE. This section covers the furnishing and installation of instrumentation and metering equipment which shall include the following principal items at the metering station.

- One Electronic Pressure Transmitter
- One 10 Inch Turbine Flowmeter, complete with Signal Converter and Isolated Signal Retransmitter Module
- One Flood Detection Switch.

13A-2. SUPPLIER'S QUALIFICATIONS. The instruments and controls shall be Bristol, Brooks, Fischer & Porter, Foxboro, Honeywell, or Rockwell International except where instruments of other manufacturers are specified.

The entire system shall be designed, coordinated, and supplied by one of the above manufacturers or his recognized and authorized agent who is regularly engaged in the business of designing and building instrument, metering, and control systems. An authorized agent will be required to prove his qualifications by submitting the following:

Authorization of agency from the major instrument manufacturer.

That he has the required financial capability.

The names of manufacturers whose products are normally supplied and the type of business relationship with each.

That he maintains a qualified technical staff and design office.

That he has the physical plant and fabricating personnel to complete the work specified.

That he has and will maintain competent service personnel to service the equipment furnished.

The names of at least three references who are users of similar equipment designed, fabricated and furnished by the agent.

13A-3. COORDINATION. Instrument, metering, and control systems supplied under this section shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications, under other contracts, and where applicable, to related existing equipment. All instruments and control devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer, and the related equipment manufacturer.

Review of drawings submitted prior to the final determination of related equipment shall not relieve the Contractor from supplying systems in full compliance with the specific requirements of the related equipment.

Coordination with other contractors and supervision of installation shall be provided by the Contractor as required during construction.

13A-4. INSTALLATION DRAWINGS. The coordinating supplier shall prepare systems and installation drawings for all interconnecting wiring and piping between components of the systems furnished and for all interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting piping and wiring shall be appropriate for the service and shall result in a properly functioning metering or control system.

13A-5. INSTALLATION. Experienced and competent supervision and qualified electrician labor shall be provided for installation of the equipment in full accordance with the drawings and instructions of the coordinating supplier. The services of the coordinating supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.

Electrical Contractor shall have a minimum of 5 years qualified experience for the installation of all Instrumentation and Metering Equipment in the Contract Customer Metering Station.

13A-5.01. Field Wiring. Field wiring materials and installation shall be in accordance with the electrical section of these specifications. All field mounted devices shall be wired to a separate terminal box for future connection by Owner.

13A-5.02. Field-Mounted Instruments. Instruments shall be mounted so that they may be readily approached and easily serviced. Pressure and differential pressure transmitters shall be wall-mounted.

13A-5.03. Field Calibration. A technical representative of the coordinating supplier shall calibrate each instrument at 5, 50, and 95 per cent of span. The representative shall provide a written calibration report for each instrument indicating the results and final tuning adjustment settings. The adjustments of each calibrated instrument shall be sealed or marked, insofar as practical, so that further adjusting by unauthorized personnel is discouraged. Instrument calibration shall be accomplished prior to a checkout of the operations of a system.

13A-5.04. Systems Check. A technical representative of the manufacturer shall participate in the checkout of metering systems. If interrelated devices furnished by other suppliers, such as valve operators, motor controls, etc., do not perform properly when placed in service, the technical representative shall use suitable test equipment to introduce simulated signals to and/or measure signals from those devices as may be required to locate the source of trouble or malfunction. A written report regarding the results of such tests shall be furnished, if requested by the Engineer, as necessary to resolve a question of responsibility for corrective measures.

13A-5.05. Installation Test Equipment. The Contractor shall provide all necessary test equipment for calibration and check of system components.

13A-6. GENERAL METERING REQUIREMENTS. All equipment furnished under this section shall be expressly selected by the equipment supplier for its superior quality for its intended performance and shall be installed in accordance with the manufacturer's instructions. Equipment and materials used shall be subject to review and shall comply with the following requirements.

13A-6.01. Power and Instrument Signals. Unless noted otherwise, electrical power supply to the instrumentation equipment will be unregulated 120 volts ac. All transmitted electronic analog instrument signals shall be 4-20 mA dc and shall be linear with the measured variable.

13A-7. INDIVIDUAL DEVICE SPECIFICATIONS.

13A-7.01. Electronic Pressure Transmitter with Local Indicator. The transmitter shall have all solid-state electronic circuitry and shall be of the 2 wire type, which requires no direct power connection to the transmitter. A 24 volt dc power source shall be provided by the Contractor. The transmitter shall be suitable for operation at temperatures from 0 F to 175 F and relative humidity of 0 to 100 per cent. All transmitter parts shall be of a corrosion resistant material. The transmitter shall have overrange protection to maximum process line pressure. Accuracy shall be plus or minus 0.5 per cent of calibrated span with repeatability of 0.1 per cent. Transmitter output shall be 4-20 mA dc without need for external load adjustments. The transmitter shall have zero and span adjustments.

The locally mounted indicator shall be integrally mounted to the transmitter or conduit mounted near the transmitter. The indicator shall have not less than a 2 inch scale with accuracy of plus or minus 2 per cent. The indicator scale shall be engraved 0 to 150 psig. The indicator shall have a weatherproof housing.

13A-7.02. Turbine Water Meter.

13A-7.02.01. 10 Inch Turbine Type Flowmeter. The meter shall have a bronze main case with 10 inch ANSI class 125 flanged ends. The meter shall have 10 inch flanged bronze body strainer on the inlet side. Operating flow range shall be 55 to 5500 gpm with an accuracy of @1.5 percent of rate. Working pressure rating shall be 150 psig. The flowmeter shall have a pulse rate type flow transmitter and a direct reading register. The register shall have a six digit totalizer which shall be fully functional without need of the electrical power source. The flowmeter shall be a Rockwell Series W-5500 DR, without exception.

A signal converter/transmitter module shall be provided with the flowmeter. The transmitter shall have an isolated 4-20 mAdc output signal which is linearly proportional to a flow range of 0 to 7000 gpm. The signal shall be capable of driving an external load of 0 to 500 ohms. The converter/transmitter shall be housed in a NEMA type 4 enclosure.

13A-7.02.01. Strainers. A strainer shall be provided ahead of the flowmeter as indicated on the drawings. Arrows shall be cast on the sides of each strainer body to indicate the direction of flow.

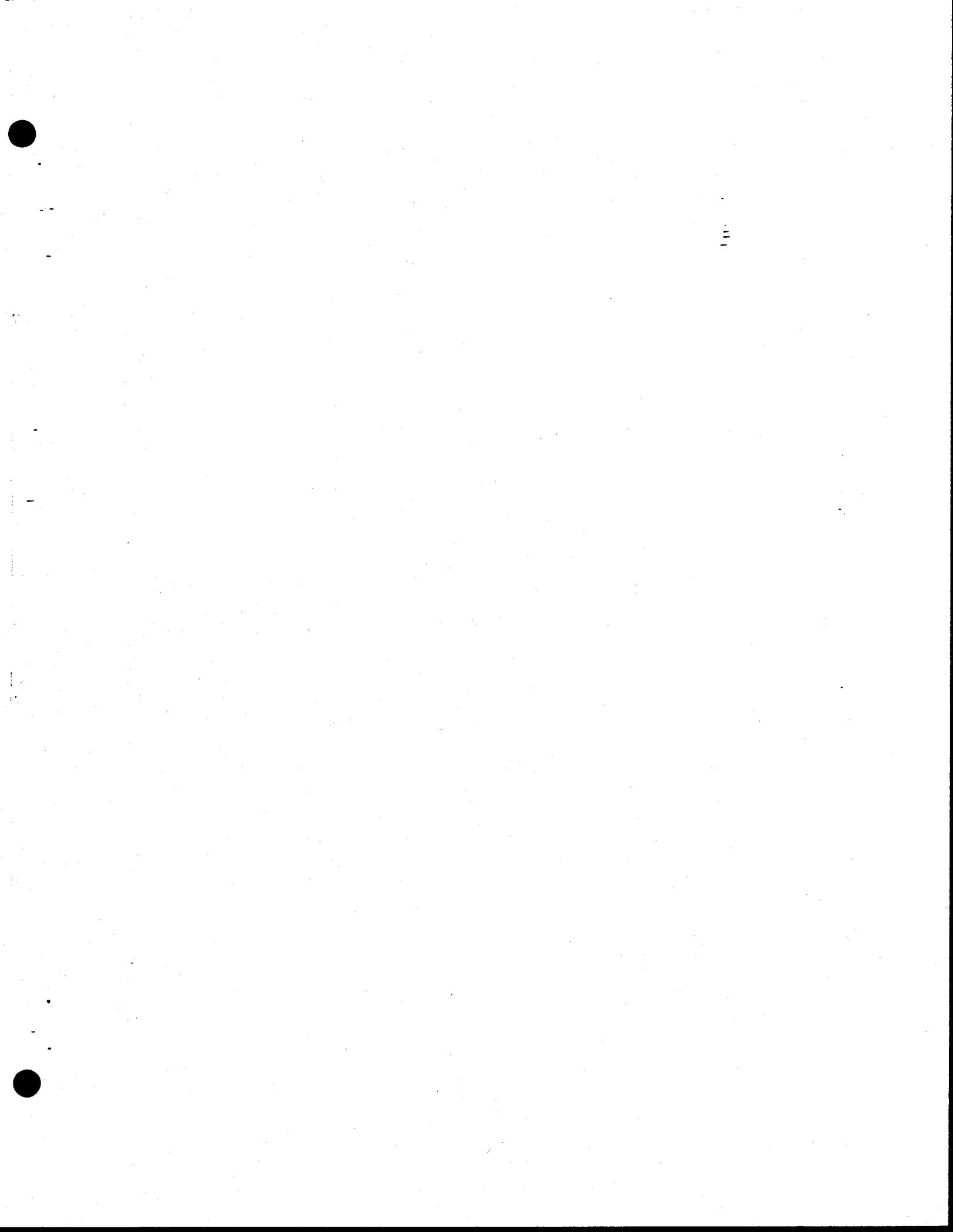
The strainer shall be bronze-bodied with monel or stainless steel screen and shall be Cash-Acme "SY-70", or Armstrong "Y Type". The blowoff from each strainer shall be equipped with a shutoff valve.

13A-7.03. Flood Detection Float Switch. The high basement level float switch shall be a float operated liquid level control designed for bracket mounting. A magnetic coupling shall be employed to transmit float movement to an electric switch. The float switch shall utilize a single snap action dry contact switch mechanism for alarm purposes. The float switch shall be provided with a perforated, stainless steel envelope welded to a forged bracket assembly to totally enclose the float, and a stainless steel bottom strap shall be tack-welded to the float envelop to act as a low-level float stop. The float switch shall be provided in a NEMA 6 enclosure. Contacts shall be rated for 10 amperes at 120 volts ac type FLS. The flood detection switch shall be Magnetrol International Co., or equal.

13A-8. DRAWINGS AND DATA. Complete fabrication, assembly, and installation drawings, wiring and schematic diagrams; details, specifications and data covering the materials used; and the parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section.

Submitted catalog cut sheets shall be clearly marked to show the applicable model number, optional features, and intended service of the device. Wiring diagrams shall show complete circuits and indicate all connections. If panel terminal designations, interdevice connec-

tions, device features and options, or other features are modified as a result of the fabrication process or factory testing, revised drawings shall be resubmitted prior to shipment of the equipment to the jobsite. Operation and Maintenance Manuals shall include complete product instruction books for each item of equipment furnished. Where instruction booklets cover more than one specific model or range of instrument, product data sheets shall be included which indicate the instrument model number, calibrated range, and all other special features.



Section 15A - CAST IRON PIPE

15A-1. SCOPE. Cast iron pipe with all fittings, jointing materials, pipe supports, anchors, blocking, and other necessary appurtenances shall conform to the Standard Specifications and the following additions.

15A-2. MATERIALS.

Restrained Push-on Joints	American "Lok-Fast" or "Lok-Ring"; Clow "Super-Lock"; U.S. Pipe "TR Flex"; or Griffin "Snap-Lok" or "Mechanical Restrained Joint".
Flanged Joints	ANSI/AWWA C115/A21.15.
Flanges	Ductile iron, ANSI/AWWA C115/A21.15, flat faced.
Bolts	ASTM A307, chamfered or rounded ends projecting 1/4 to 1/2 inch beyond outer face of nut.
Nuts	ASTM A307, hexagonal, ANSI B18.2, heavy semifinished pattern.
Gaskets	ASTM D1330, Grade I rubber, full faced type, 1/8 inch thick.
Wall Castings	Mechanical joint with waterstop and tapped holes; single casting or fabricated ductile iron, "Adjustable Wall Pipe" as manufactured by Midwest Pipe Fabricators, Omaha, Nebraska. All holes shall be sized in accordance with Figure 1-15A provided with removable plug.
Mechanical Joints with Tie Rods	See details at the end of this section.
Tie Rods	ASTM A307.
Steel Pipe	ASTM A120, standard weight.
Washers	ANSI B18.22.1, plain steel.

Grooved End Couplings

Pipe Ends	Grooved with "rigid radius groove".
Couplings	Victaulic Style 31.
Flanged Coupling Adapters	Rockwell Type 912 with anchor studs, 12 inch and under.
Shop Coating and Lining	
Cement Lining	ANSI/AWWA C104/A21.4.
Shop Primer	Cook "391-N-142 Clorocon Barrier Coat", Koppers "No. 10 Inhibitive Primer", Mobil "13- R- 28 Chromox Primer", or Tnemec "77 Chem-Prime".
Asphaltic Coating	Manufacturer's standard
Rust Preventive Compound	Houghton "Rust Veto 344" or Rust-Oleum "R9".

15A-3. SHOP COATING AND LINING. The interior of all pipe shall be cement lined. The interior of all fittings shall be asphaltic lined.

The exterior surfaces of all pipe and fittings which will be exposed in interior locations shall be shop primed. Flange faces shall be coated with rust preventive compound. Exterior surfaces of all other pipe and fittings shall be asphaltic coated.

15A-4. FIELD JOINTS. Joints in buried locations shall be mechanical joint or push-on type unless otherwise indicated on the drawings. Bells on wall castings and wall sleeves shall be mechanical joint with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the drawings. Grooved end couplings may be used in lieu of flanges, provided rigid grooving is used to preclude pipe movement.

15A-5. MECHANICAL JOINTS. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Overtightening bolts to compensate for poor installation practice will not be permitted.

The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges

shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

15A-6. PUSH-ON JOINTS. The pipe manufacturer's instructions and recommendations for proper jointing operations shall be followed. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

Pipe ends for restrained joint pipe shall be prepared in accordance with the pipe manufacturer's recommendations.

15A-7. FLANGED JOINTS. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate, so that gasket compression is uniform.

15A-8. FLANGED COUPLING ADAPTERS. Flanged coupling adapters shall be installed in strict accordance with the coupling manufacturer's recommendations. After the pipe is in place and bolted tight, the proper location of holes for the anchor studs shall be determined and the pipe field drilled. Hole diameter shall be not more than 1/8 inch larger than the diameter of the stud projection.

15A-9. MECHANICAL COUPLINGS. Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. Pipe ends shall be clean and smooth. A space of at least 1/4 inch and not more than one inch shall be left between the pipe ends.

15A-10. GROOVED END JOINTS. Grooved end couplings shall be installed in accordance with coupling manufacturer's recommendations. Completed joints shall be rigid and shall not allow angular deflection or longitudinal movement.

15A-11. POLYETHYLENE TUBE PROTECTION. Cast iron pipe shall be provided with polyethylene tube protection installed in accordance with AWWA C105. Tubing shall be installed on piping in accordance with Method A.

15A-12. WALL CASTINGS. Unless otherwise indicated on the drawings, wall castings shall be provided where cast iron pipes pass through concrete or masonry walls.

15A-13. REDUCERS. Reducers adjacent to flowmeters shall be eccentric pattern. Eccentric reducers shall be installed with the straight side on top so that no air traps are formed. Unless otherwise indicated on the drawings, all other reducers shall be concentric pattern.

15A-14. OUTLETS. Where a 12 inch or smaller branch outlet is indicated and the diameter of the line pipe is at least twice the diameter of the branch, either a tee or a tapping saddle will be acceptable.

15A-15. REACTION ANCHORAGE. All exposed piping with mechanical couplings, push-on or mechanical joints, or similar joints subject to internal pressure shall be anchored, or harnessed to preclude separation of joints. All unlugged bell and spigot or all-bell tees, Y-branches, bends deflecting 22-1/2 degrees or more, and plugs which are installed in buried piping subjected to internal hydrostatic heads in excess of 30 feet shall be provided with suitable reaction anchors, joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure.

Anchorage, or other supports for fittings installed in fills or other unstable ground, above grade, or exposed within structures, shall be provided as required by the drawings or as directed by the Engineer.

15A-16. LEAKAGE. All joints shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the Standard Specifications shall be repaired by and at the expense of the Contractor.

15A-17. DIMENSIONS. The thickness class for cast iron pipe shall be as indicated in the following table:

<u>Location</u>	<u>Nominal Size Inches</u>	<u>ANSI Thickness Class</u>
Air Release & Blowoff Assemblies	6	53
Contract Customer Metering Station	12	52
Contract Customer Metering Station	16	51

Note

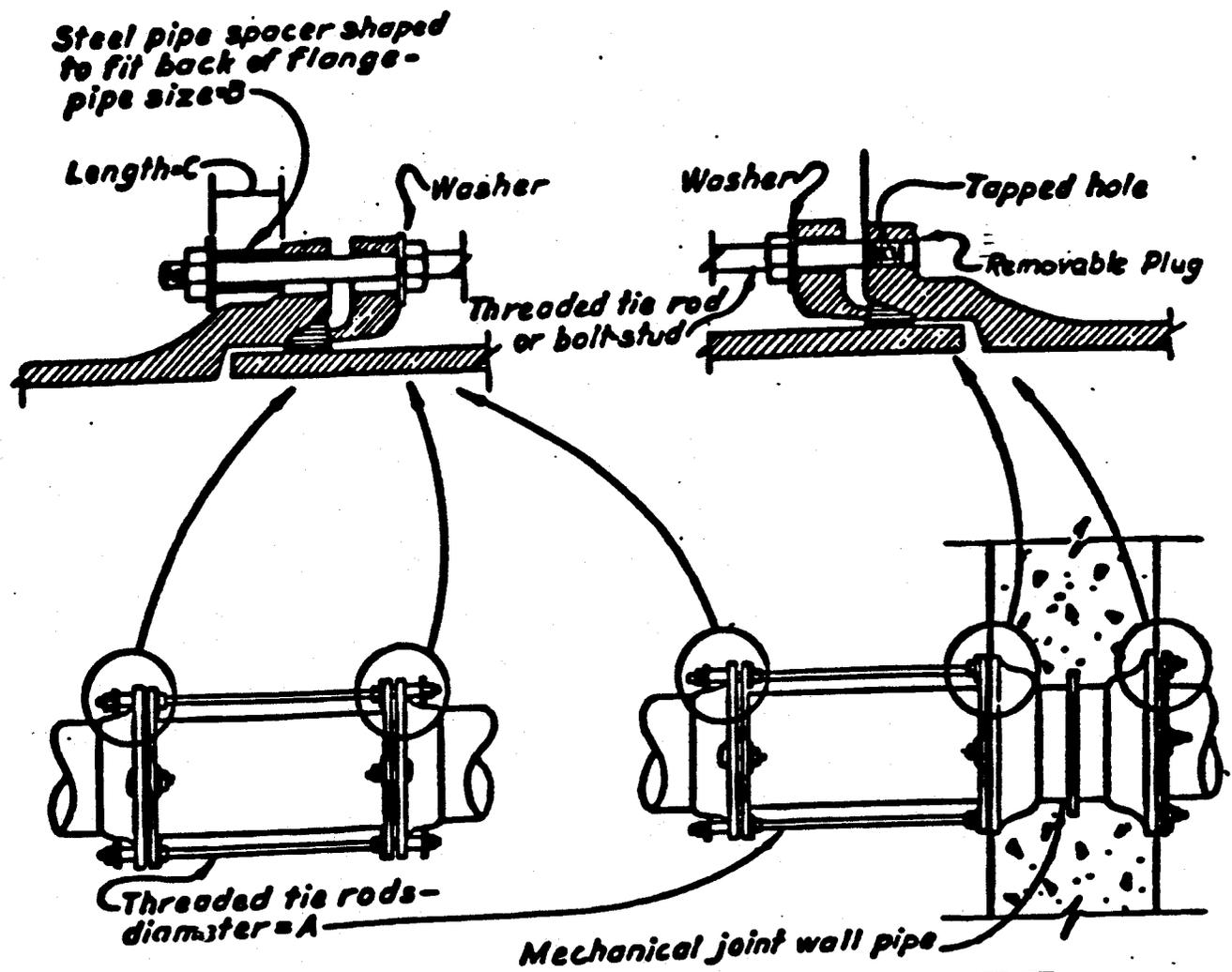
- 1] The specified thickness class includes corrosion allowance and foundry tolerance
- 2] All cast iron pipe shall have harnessed joints.

Pipe wall thickness for grooved and threaded pipe shall be increased if necessary to comply with the following minimum thicknesses:

<u>Pipe Size</u>	<u>Minimum Thickness Class</u>	
	<u>Threaded Ends</u> (1)	<u>Grooved Ends</u> (2)
4-16 inch	53	53

- (1) Complies with ANSI/AWWA C115/A21.15 for minimum pipe wall thickness for threaded flanges.
- (2) Grooved couplings are cataloged through 24 inch.

15A-18. DRAWINGS AND DATA. Complete layout drawings, details, and specifications covering all cast iron piping and accessories shall be submitted in accordance with the procedure set forth in the submittals section.



Pipe Size	A Tie Rod		B Spacer Nom. Size	C Spacer Length
	Dia.	No.		
6"	5/8"	2	3/4"	2 1/2"
16"	5/8"	8	3/4"	2 1/2"

Notes:

1. Except where tie rods are required, bolts for follower rings shall be bolt-studs on wall pipes and tee head bolts in other locations.
2. All holes in wall pipes shall be topped and shall be sized in accordance with column A.

MECHANICAL JOINTS WITH TIE RODS

BLACK & VEATCH
ENGINEERS-ARCHITECTS
KANSAS CITY, MISSOURI

FIGURE I-18A

Section 15B - BUTTERFLY VALVES

15B-1. SCOPE. All butterfly valves shall conform to the Standard Specifications and the following additions.

15B-2. GENERAL. Valves shall be short-body type.

15B-3. BUTTERFLY VALVE SCHEDULE.

<u>Quantity</u>	<u>Size inches</u>	<u>Service</u>	<u>Type of Installation</u>	<u>AWWA Class(1)</u>	<u>Type of Operator</u>	<u>Operator Torque Capability(2) inch-pounds</u>	<u>Operating Time seconds</u>
5	36	Transmission Main	Vault	150B-F	wrench-nut	99,420	
1	30	Transmission Main	Vault	150B-F	wrench-nut	60,398	
1	20	Transmission Main	Buried	150B-MJ	wrench-nut	19,866	
1	16	Transmission Main	Buried	150B-MJ	wrench-nut	11,236	
1	16	Customer Metering Sta.	Vault	150B-F	Electric	11.236	60

(1) Suffix letters define valve ends as follows:

- F = Flanged
- MJ = Mechanical joint

(2) The manufacturer's rated torque capacity for each butterfly valve operator shall be at least 90 per cent of the operator torque capability specified herein. If valves with an AWWA Class designation higher than listed above are furnished, operator torque capabilities shall be increased accordingly and to the satisfaction of the Engineer.

15B-4. VALVE OPERATORS. Operator mounting arrangements and handwheel positions shall be as indicated on the drawings or as directed by the Engineer.

Each valve operator, except operators that are buried, shall have a valve disc position indicator mounted on the end of the valve shaft.

15B-4.01. Manual Operators. Unless otherwise required by the Owner, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.

Handwheel diameter shall be at least 8 inches but not more than 24 inches for 30 inch or smaller valves, or 30 inches for 36 inch valves.

Wrench nuts shall be standard AWWA wrench nuts as described in Section 3.16 of AWWA C500.

15B-4.02. Modulating Electric Operator. The modulating valve operator in the contract customer metering station shall be E-I-M "Series 2000, Futronic III Control", or Limitorque Corporation "Limitorque, Modutronic", integrally assembled to the valve and shall consist of the motor, gearing, handwheel, limit and torque switches, control module, lubricants, heating elements, wiring, and terminals, all constructed as a self-contained unit with a cast submersible housing.

Operator shall be designed for a 120 volt ac, single phase, power supply.

Operator designed for submersible service shall be designed to prevent the entrance of water when submerged 20 feet for 48 hours.

The operator shall be designed to require not more than 90 seconds nor less than 60 seconds, at maximum motor speed, to operate from fully open to fully closed position or the reverse.

The operator motor may be mounted horizontally adjacent to or vertically above the reduction gearing. Gearing may be either oil bath or grease lubricated. If grease lubrication is used, in no case shall motors be mounted vertically below the gearing.

15B-4.02.01. Motor. The motor shall be totally enclosed, high torque design made expressly for valve operator service, capable of providing maximum control of speed over entire torque range. The motor shall be designed in accordance with NEMA standards, provided with Class F insulation, rated at 75 C rise over a 40 C ambient for continuous modulating service. Motor bearings shall be permanently lubricated.

15B-4.02.02. Gearing. Power gearing shall consist of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all suitably lubricated, designed for 100 per cent overload, and effectively sealed against entrance of foreign matter. Gearing shall be designed to be self-locking so that actuation of a torque switch from a torque overload will not allow the operator to restart until the problem has been eliminated. Gearing need not bear an AGMA nameplate. The gearing mechanism shall be constructed to permit changes in the field of the reduction gear ratio.

Operators shall be designed so that the motor comes up to speed before the stem load is encountered in either the opening or closing operations.

15B-4.02.03. Handwheel Mechanism. The handwheel shall not rotate during motor operation. During handwheel operation the motor shall not turn. The operator shall be responsive to electrical power and control at all times, and when under electrical control, shall instantly disengage the handwheel. The handwheel shall rotate counterclockwise to open the valve. An arrow indicating the opening direction and the word OPEN shall be cast on the handwheel. The force required to operate the handwheel shall not exceed 80 pounds.

15B-4.02.04. Torque Switches. Torque and thrust loads in both closing and opening directions shall be limited by torque limit switches. Each torque switch shall be provided with a micrometer adjustment and reference setting indicator. The adjustment shall permit a variation of approximately 40 per cent in torque setting. Switches shall have a rating of not less than 6 amperes at 120 volts ac and 2.2 amperes at 115 volts dc.

15B-4.02.05. Geared Limit Switches. The electric operator shall have space for four geared limit switch assemblies and each switch assembly shall have four separate limit switches. Each switch assembly shall be geared to the driving mechanism and shall be independently adjustable to trip at any point at and between the fully open and fully closed valve position. Switches shall have an inductive contact rating of not less than 6 amperes at 120 volts ac, 3 amperes at 240 volts ac, 1.5 amperes at 480 volts ac, 2.2 amperes at 115 volts dc, and 1.1 ampere at 230 volts dc.

The operator shall be furnished with two limit switch assemblies.

15B-4.02.06. Position Transmitter. The electric operator shall be provided with a 1,000 ohm, 2 watt, 3 wire type slide-wire position transmitter suitable for operation at 120 volts ac. The slide-wire resistance change shall be linearly proportional to the valve position and shall have a resolution of at least one per cent of span. The slide-wire shall operate in conjunction with the position indicating system specified in the instrumentation section. This slide-wire shall be in addition to any slide-wire transmitter required for the position control feedback.

15B-4.02.07. Heating Elements. Space heating elements shall be provided to prevent condensation in the geared limit switch compartment. Heating elements shall be rated 120 volts ac. Heaters shall be continuously energized.

15B-4.02.08. Terminal Facilities. Terminal facilities for connection to motor leads, switches, slide-wire type position transmitter, and heating elements shall be provided in readily accessible terminal compartments.

15B-4.02.09. Control Module. A control module shall be furnished with the motor operated valve and shall be of the electronic solid state type with proportional power variation to control the speed and rotation of the dc motor. The control module shall be mounted within the valve operator limit switch housing. The module shall accept a standard 4-20 mA dc analog input signal with a load impedance of not greater than 400 ohms. The control module shall contain adjustments for span, zero, gain, and deadband.

The operator shall have a slide-wire type position feedback potentiometer which provides a position feedback signal to the control module. The feedback potentiometer shall be provided with anti-backlash gearing or shall be operated directly from the valve shaft as required to minimize hysteresis.

A Manual-Automatic selector switch shall be provided on the limit switch housing.

The operator shall have Open-Close momentary contact push-buttons on the limit switch housing for local electric operation in the manual mode.

15B-4.02.10. Control Performance. For any operating torque within the specified range of the valve operator, the valve and operator shall perform within these specified limits.

Linearity

Linearity of actual valve position as compared to demand signal shall be within plus or minus 4.0 per cent of span over the entire operating range.

Repeatability

For any repeated demand signal to valve operator, the actual valve position shall be repeated within 0.5 per cent of span.

Deadband

Deadband of the valve operator shall be adjustable from 1.0 per cent to 10 per cent of span.

Hysteresis

For any repeated demand signal to the valve operator, from either an increasing or a decreasing direction, the actual valve position shall be repeated within one degree of valve shaft rotation.

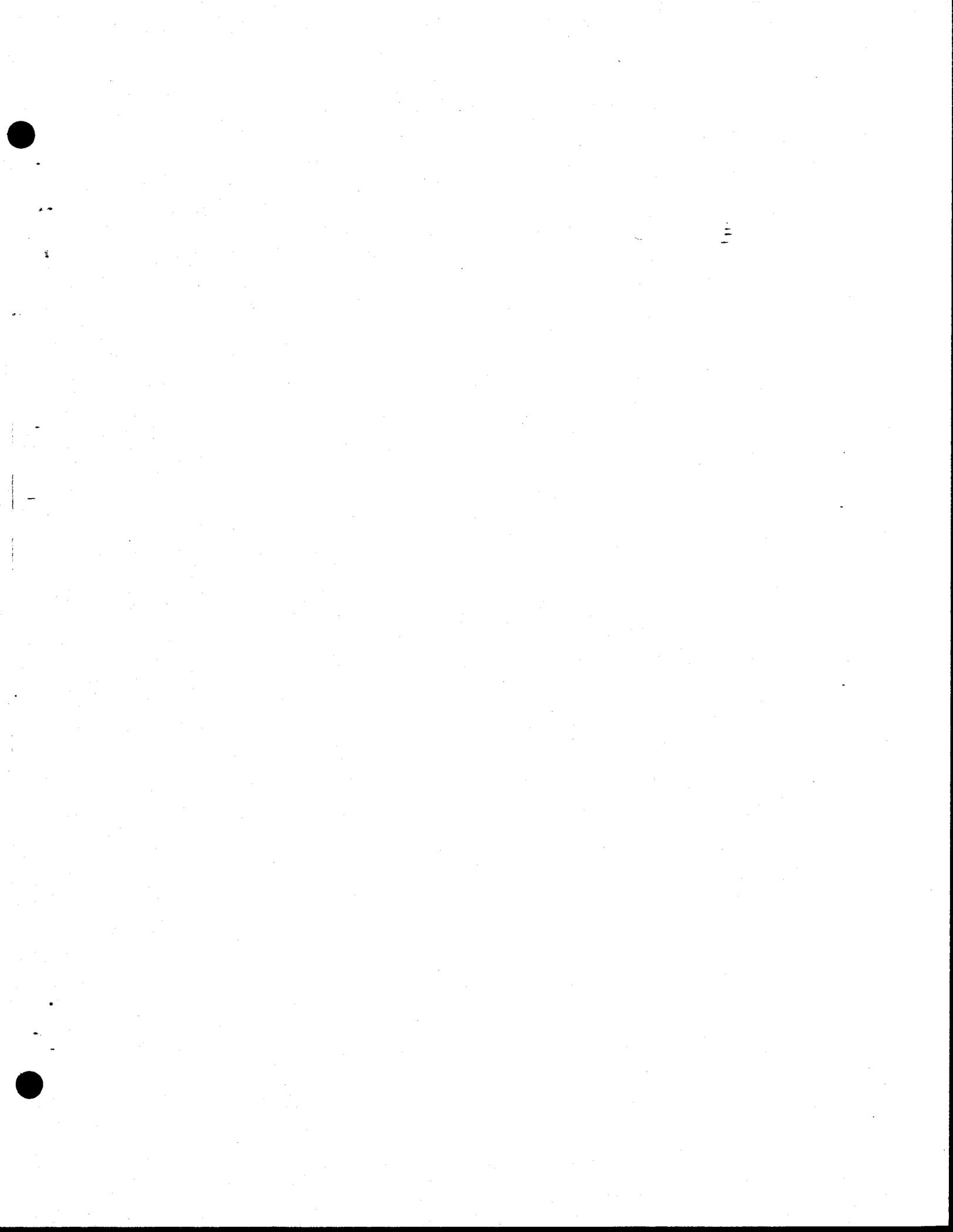
15B-5. DRAWINGS AND DATA. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the submittals section.

Drawings submitted shall include separate wiring diagrams for the electrically operated or controlled valve and the electrical control equipment therefor. Each drawing shall be identified with the name as used in these specifications.

Certified copies of the results of all tests as required by Section 5 of AWWA C504 together with an affidavit of compliance as indicated in Section 1.5 shall be furnished to the Consulting Engineer before the valves are shipped.

(MESA, ARIZONA)
(11785.PLD)

15B-5



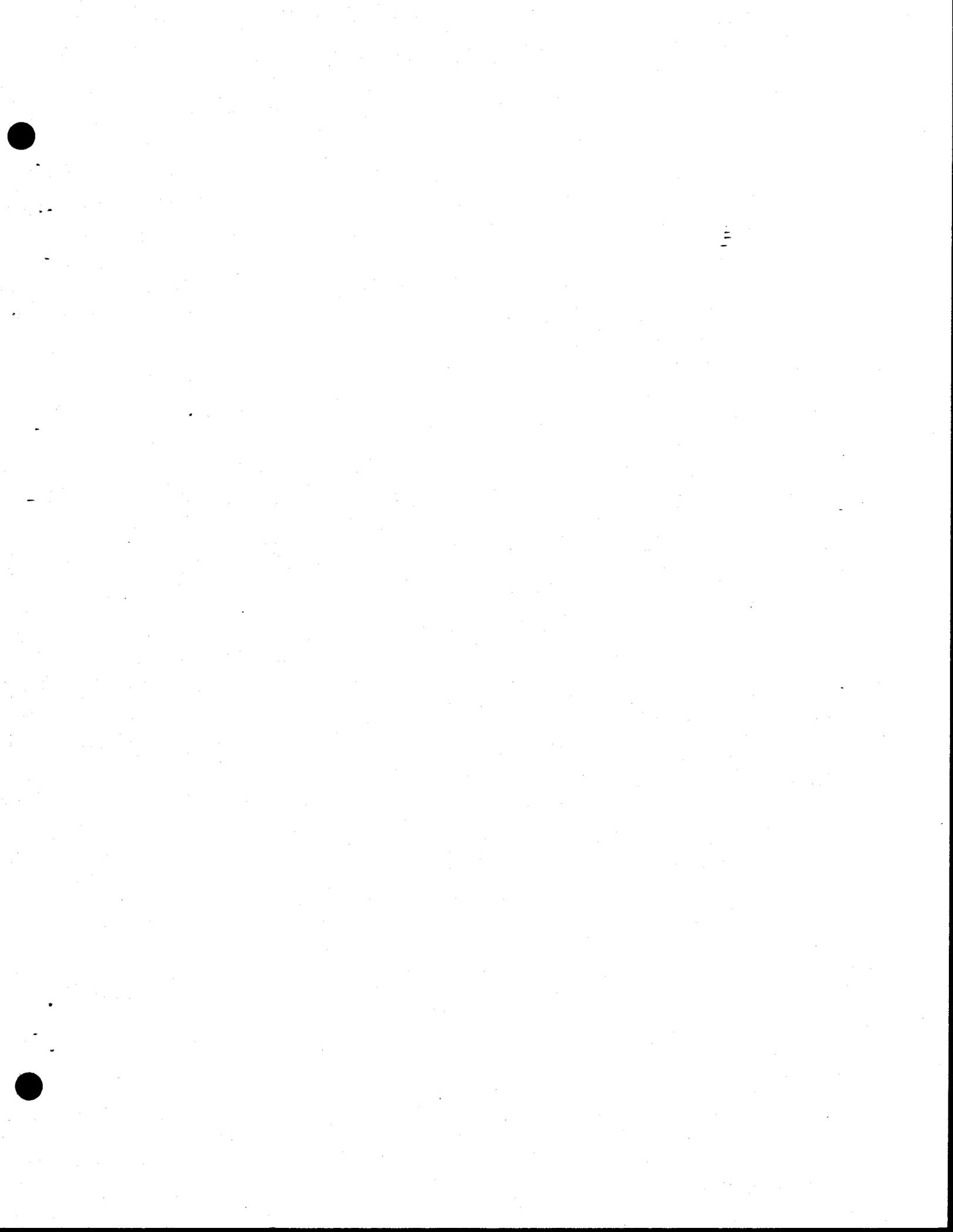
Section 15C - GATE VALVES

15C-1. SCOPE. All gate valves shall conform to the Standard Specifications and the following additions.

15C-2.01. Manual Operators. All valves shall be provided with manual operators. Unless otherwise shown or specified, each manual operator shall be equipped with an operating wheel.

15C-3. GATE VALVES. Gate valves shall be double disc type. Gate valves installed inside structures shall be non-rising stem type with stuffing box stem seals.

15C-4. DRAWINGS AND DATA. Complete specifications, data, and catalog cuts, or drawings covering the items furnished under this section shall be submitted in accordance with the submittals section.



Section 16A - ELECTRICAL

16A-1. SCOPE. This section covers the installation of electrical equipment furnished under other sections; installation of equipment furnished by the Owner; and furnishing and installation of all additional equipment and materials needed for the electrical requirements of this contract.

16A-2. CODES AND PERMITS. All work shall be performed and all materials shall be in accordance with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. The Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

16A-3. RELATION TO OTHER WORK. Electrical work shall be done to conform with the construction schedule and progress of other trades. Electrical apparatus on all equipment shall be handled, set in place, connected, checked out, serviced, and placed in readiness for proper operation.

16A-4. POWER AND TELEPHONE SERVICE ENTRANCES. The Contractor shall familiarize himself with the service installation requirements of the Salt River Project (SRP) and Mountain Bell Telephone (MBT), and shall furnish and install the service equipment in complete accordance therewith.

Power service equipment shall include conduit and wire from panel 'L1' to meter pedestal, meter pedestal pad, and two inch conduit from meter pedestal to base of SRP pole (for SRP conductors). Meter pedestal will be provided by SRP and installed by Contractor. Contractor shall provide sufficient cable to terminate on meter.

Telephone service provisions shall include a termination box and an empty conduit from the box to the point of service. The box shall be NEMA Type 4, galvanized, surface mounted, not less than 12 by 18 by 6 inches deep, or larger if required. The box shall have a hinged door and an inner mounting board of 3/4 inch exterior plywood with two coats of varnish.

A weatherhead shall be provided on each service riser conduit if required.

The Contractor shall coordinate details and timing of service entrance installations with SRP and MBT.

16A-5. GENERAL PROCEDURE. The following procedures shall be used in performing electrical work except as otherwise specified or indicated on the drawings.

16A-5.01. Care of Equipment. During construction, all electrical equipment insulation shall be protected against absorption of moisture and metallic components shall be protected against corrosion by strip heaters, lamps, or other suitable means. This protection shall be provided immediately upon receipt of the equipment and maintained continuously.

16A-5.02. Setting of Equipment. All equipment shall be installed level and plumb. Sheet metal junction boxes, equipment enclosures, sheet metal raceways, and similar items, mounted on water or earth bearing walls shall be separated from the wall not less than 1/4 inch by corrosion-resistant spacers.

16A-5.03. Sealing of Equipment. All outdoor equipment shall be permanently sealed at the base, and all openings into equipment shall be screened or sealed as required to prevent the entrance of rodents and insects the size of wasps and mud-daubers. Sealing material at the base shall be concrete grout. Small cracks and openings shall be sealed from inside with non-hardening duct sealing compound.

16A-5.04. Installation of Conduit. In general, conduit shall be concealed where possible. Large conduit may be exposed unless otherwise specified or shown on the drawings. No conduit shall be exposed in water chambers unless so shown on the drawings. Conduit installation shall conform to the following requirements:

- a. Terminations and connections of rigid and intermediate metal conduit shall be taper threaded. Conduits shall be reamed, free of burrs, and terminated with conduit bushings.
- b. Exposed conduit shall be installed parallel to structural members and surfaces.
- c. Two or more conduits in the same general routing shall be parallel with symmetrical bends.
- d. Conduit shall be rigidly supported by galvanized or cadmium plated hardware and framing materials including nuts and bolts.
- e. Conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside.
- f. Conduits shall be installed between the reinforcing steel in walls or slabs which have reinforcement in both faces. In slabs which have only a single layer of reinforcing steel, conduits shall be placed under the reinforcement.

- g. Conduit across structural joints where structural movement is allowed shall have an O- Z "Type DX" bonded, weathertight expansion and deflection fitting of that conduit size.
- h. Conduits through roofs shall be flashed and sealed watertight.
- i. Conduit shall be neatly grouted into any openings cut into structures.
- j. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.
- k. Conduit installed horizontally shall allow headroom of at least 7 feet except where it may be installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.

16A-5.05. Installation of Underground Conduit. All excavation, backfilling, and concrete work shall conform to respective sections of these specifications. Underground conduit shall conform to the following requirements:

- a. All underground conduits not otherwise indicated on the drawings shall be concrete encased, galvanized, rigid steel. No underground conduit shall be smaller than one inch.
- b. Concrete encased conduit shall have minimum concrete thicknesses of 2 inches between conduits, of 3 inches over conduits where not reinforced, or of 3 inches over reinforcing.
- c. Concrete encasement on exposed outdoor conduit risers shall continue to 3 inches above grade with top crowned and edges chamfered.
- d. Underground conduits indicated not to be concrete encased shall be galvanized rigid steel with a factory applied polyvinyl chloride coating having a nominal thickness of 40 mils.
- e. Underground conduit bend radius shall be not less than 2 feet at vertical risers nor less than 3 feet elsewhere.
- f. Underground conduits and conduit banks shall have 2 feet minimum earth cover except where indicated otherwise.

- g. Underground conduit banks through building walls shall be cast-in-place, or concreted into boxouts with water stops on all sides of the boxout. Water stops are covered in the cast-in-place concrete sections.
- h. Conduits not encased in concrete and passing through walls which have one side in contact with earth shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.
- h. Telephone cables shall be isolated from raceways, conduits, and boxes for other circuits.
- i. Intercommunications cables shall be isolated from all power wiring raceways, conduits and boxes.

16A-5.06. Sealing of Conduits. After cable has been installed and connected, conduit ends shall be sealed by nonhardening sealing compound into conduits to a minimum depth equal to the conduit diameter. This shall apply for all conduits at handholes, manholes, building entrance junction boxes, and for one inch and larger conduit connections to equipment.

16A-5.07. Installation of Cable. Care shall be taken to protect the cable and avoid kinking of conductors, cutting or puncturing the jacket, contamination by oil or grease, or damaging in any manner. Cable installation shall conform with the following requirements:

- a. Stranded conductor cable shall be terminated by lugs, cup washers, or pressure type connectors. Stranded cables shall not be wrapped around screw type terminals.
- b. Stranded conductor cable shall be spliced by solder or crimp type connectors. Twist-on wire connectors shall not be used on stranded cable.
- c. Cables may be spliced only at readily accessible locations.
- d. Cable terminations and splices shall be made as recommended by the cable manufacturer for the particular cable and service conditions.
- e. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.
- f. Cable pulling lubricants shall be as recommended by the cable manufacturer for that particular type cable.

16A-5.08. Installation of Grounding Materials. Electrical system grounding and equipment grounding shall be installed in compliance with the National Electrical Code and shall conform with the following applicable requirements:

- a. All ground conductors shall be bare, soft drawn, copper cable or bar, not smaller than 12 AWG.
- b. Ground cable splices and joints which will be inaccessible upon completion of construction shall be made by the "Cadweld" process.
- c. Ground cable through building exterior walls shall enter within 3 feet below finish grade and shall be prepared with a water stop. Unless otherwise indicated, the water stop shall include filling the space between the strands with solder and soldering a 12 inch copper disc over the cable.
- d. Lighting fixtures and convenience outlets shall be grounded through the conduit system.
- e. Convenience outlet receptacles shall be grounded by a bare copper conductor in addition to the conduit connection.
- f. Ground connections to equipment and ground buses shall be by copper ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures other than explosionproof, or by grounding locknuts or bushings. Ground cable connections to anchor bolts; against gaskets, paint, or varnish; or on bolts holding removable access covers will not be permitted.
- g. The grounding system shall be bonded to station piping by connection to the first flange inside the building on either a suction or discharge pipe which will form a good ground connection. The connection shall be made with a copper bar or strap by drilling and tapping the flange and providing a bolted connection.
- h. Ground conductors on equipment shall be formed to the contour of the equipment and firmly supported.
- i. All ground connection hardware, bolts, and nuts shall be high strength, high conductivity copper alloy.
- j. Ground rods not described elsewhere shall be 5/8 inch by 8 foot, Copperweld.

16A-6. OUTLETS AND FITTINGS. Concealed conduit systems shall have flush-mounted switch and convenience outlets. Exposed conduit systems shall have surface mounted switch and convenience outlets.

16A-6.01. Conduit Boxes and Fittings.

- a. Boxes and fittings in exposed conduit systems shall be galvanized or cadmium plated, threaded, malleable iron, Appleton.
- b. Boxes and fittings in conduit systems encased in concrete, in exterior faces of walls, in water- or earth-bearing walls, and where weatherproof devices are required shall be galvanized or cadmium plated, threaded, malleable iron, Appleton.
- c. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement required in each case to avoid unnecessary conduit bends and fittings.

16A-6.02. Device Plates.

- a. Galvanized or cadmium plated device plates shall be used on surface-mounted outlet boxes where weatherproof plates are not required.
- b. Device plates on flush-mounted outlet boxes where weatherproof plates are not required shall be Type 302 stainless steel.
- c. Device plate mounting hardware shall be countersunk and finished to match the plate.
- d. Oversized plates shall be installed where standard plates do not fully cover the wall opening.
- e. Device plates for switches outdoors or indicated as weatherproof shall have provisions for padlocking switches "On" and "Off", and shall be Appleton FSK-1VS, or Crouse-Hinds DS 185.
- f. Flush-mounted weatherproof plates shall be provided with an adaptor plate, Crouse-Hinds FS031.

16A-6.03. Wall Switches.

- a. Switches on ac lighting panel load circuits through 240 volts shall be 20 ampere, 120/277 volt, Hubbell 1221 through 1224.
- b. Wall switches shall be mounted 3'- 6" above floor or grade.

16A-7. JUNCTION BOXES AND WIRING GUTTERS. Boxes and gutters shall be constructed of sheet steel and galvanized after fabrication. Box and gutter sizes, metal thickness, and installation details shall comply with the National Electrical Code. All boxes shall be of NEMA Type 4 construction.

16A-8. LIGHTING FIXTURES. Lighting fixtures shall be furnished and installed as described in the fixture schedule and indicated on the drawings. The drawings indicate the general location and arrangement of fixtures desired. Fixtures in rows shall be aligned both vertically and horizontally unless otherwise required. Fixtures shall be clear of pipes, mechanical equipment, structural openings, indicated future equipment and structural openings, and other obstructions. Lighting fixtures shall be furnished complete with lamps.

Pendant fixtures shall have swivel type box covers and threaded conduit pendants unless otherwise specified.

16A-9. RIGID CONDUIT. Unless otherwise specified or indicated on the drawings, all raceways shall be heavy wall, galvanized, rigid steel conduit, ANSI C80.1 with bonded polyvinyl choride coating, Pittsburgh Standard "Plasti-bond", Rob Roy Industries "Plastibond", or equal. A coating of 0.040 inch thickness shall be securely bonded to all conduit, couplings, and fittings. Bond strength between metal and plastic shall be equal to or greater than the tensile strength of the plastic coating. Each coupling shall have a plastic sleeve extending one pipe diameter or 2 inches (whichever is less) beyond the end of the coupling. The inside diameter of the sleeve shall be the same as the outside diameter of the pipe used with it. The wall thickness of the sleeve shall be the same as the plastic jacket on the pipe. Conduit shall be UL listed. Coating injuries shall be repaired.

16A-10. FLEXIBLE CONDUIT. Vinyl jacketed, flexible steel conduit, "Sealtite", with Appleton Type ST or STB watertight connectors, shall be used where flexible connections are necessary, including each motor without a flexible cord. Lengths shall be a minimum without sharp bends.

16A-11. CABLE. The cable furnished shall conform to the Cable Data sheets bound at the end of this section and as described herein.

16A-11.01. Cable Manufacturers. The cable furnished shall be produced by one or more of the manufacturers indicated in the following table. Each "X" in the table indicates an acceptable manufacturer of the indicated cable.

	600 V Power & Ltg Cable	Instrument Cable
Anaconda-Ericsson Power Cable Division	X	X

BIW Cable System, Inc.	X	X
Brand-Rex Co. Eaton Corp., Samuel Moore Operations, Dekoron Div.		X
General Electric Co.	X	X
The Okonite Co.	X	X
Phelps Dodge Cable & Wire Co.	X	
Pirelli Cable Corp.	X	
Rome Cable Corp.	X	X

16A-11.02. Lighting Cable. Lighting cable shall be provided in lighting and receptacle circuits only. Lighting and receptacle circuits for underground use and cable 8 AWG or larger shall be as specified for 600 volt power cable.

16A-11.03. 600 Volt Power Cable. Cables in power, control, indication, and alarm circuits operating at 600 volts or less, except where lighting, multiconductor control and instrument cables are permitted or required, shall be 600 volt power cable.

16A-11.04. Instrument Cable. Cable for circuits to electronic instrumentation, and metering, where described on the one-line diagrams as 1-PR, shall be two conductor instrument cable twisted for magnetic noise rejection and protected from electrostatic noise by a total coverage shield.

16A-12. LIGHTING PANEL. The lighting panel shall be dead front, circuit breaker, 120/240 volt, single phase, panelboard type in accordance with the drawings and the following.

16A-12.01. Cabinet. The panel shall have a weatherproof NEMA Type 4 enclosure suitable for wall mounting. The enclosure shall have a door with latch and lock. A directory inside the door shall have the panel and all circuit identities neatly typewritten at completion of the contract.

A ground stud bolt shall be provided through the cabinet with a removable 1/0 AWG bond to the panel ground bus and an external clamp connector for a station ground cable.

16A-12.02. Circuit Breakers. Circuit breakers shall be thermal-magnetic, bolt-in, individually front replaceable, and shall indicate "On", "Off", and "Tripped". Breakers indicated as multiple-pole shall be

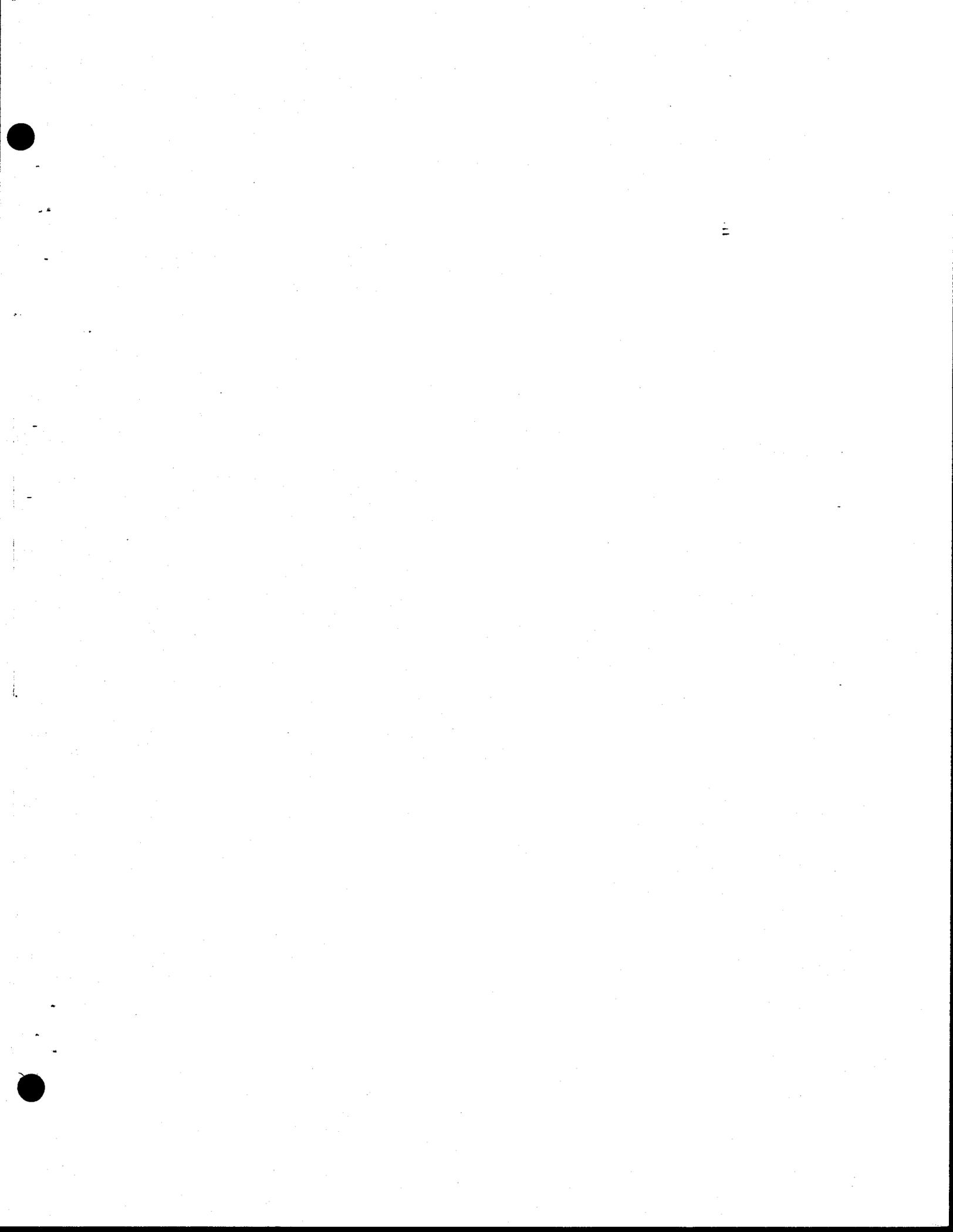
common trip. Breakers shall have interrupting ratings not less than 10,000 amperes. Breakers and provisions for future breakers shall be provided in the quantities, poles, and ampere ratings shown on the drawings. Breakers shall be single pole, 20 ampere except as shown otherwise.

16A-12.03. Buses. The panel shall have main and neutral buses insulated from the cabinet and a ground bus. Buses shall be copper with ampere ratings and main lugs or breaker as indicated. The ground bus shall be similar to a neutral bus and shall have a good ground connection to the cabinet, a removable bond to the neutral bus, clamp type lugs for the ground cable in each supply conduit, and connections for a ground cable in each load conduit.

16A-13. DRAWINGS AND DATA. All materials and equipment shall be submitted for review in accordance with the submittals section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:

- a. Lamp fixture descriptive sheets shall show the fixture number, or symbol for which the sheet applies.
- b. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.
- c. Sheets or drawings showing more than the particular item under consideration shall have crossed out all but the pertinent description of the item for which review is requested.
- d. Equipment and materials descriptive literature not readily cross referenced with the drawings or specifications shall be identified by a suitable notation.
- e. Schematics and connection diagrams for all electrical equipment shall be submitted for review. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted, unless it is clearly marked to show the intended connections.

In addition to the complete specifications and descriptive literature, a sample of the largest size of each type of cable shall be submitted for review before installation. Each sample shall have a legible and complete surface printing of the cable identification.



APPENDIX A

TEST BORING LOGS

THESE REPORTS ARE FOR REFERENCE ONLY AND ARE NOT A
PART OF THE CONTRACT DOCUMENTS

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Geotechnical Investigation
Water Pipeline and Water Reservoir
Brown to Crismon Road
Mesa, Arizona
October 4, 1984

INTRODUCTION

This report contains the results of our geotechnical investigation for the proposed water pipeline to be located along Brown Road extending east from the Mesa Water Treatment Plant to Crismon Road then north along Crismon Road for a half mile to the proposed water reservoir site located on the west side of Crismon Road in Mesa, Arizona. The purpose of these services is to provide information and recommendations along the pipeline relative to excavation conditions, slope stability and soil resistivity, and at the reservoir site relative to foundation design, lateral earth pressures, site preparation and excavation conditions.

PROPOSED CONSTRUCTION

We understand that the proposed water pipeline will be buried 6 to 8 feet below existing grade. The proposed reservoir will consist of one 175-foot-diameter concrete tank or two 85-foot-diameter concrete tanks extending approximately 30 feet below existing grade. Total storage volume will be 5.0 million gallons, and each tank will be 32 feet high with an overflow elevation of 1730 feet. Wall loads are assumed to be 3 to 6 klf.



SITE CONDITIONS

Area Geology: The pipeline alignment is situated on a broad alluvial fan formed by the erosion of the Userly Mountains located to the east and north and is near the eastern end of the Paradise - Queen Creek Valley. The reservoir site is situated at the base of a granite hill which protrudes through the adjacent alluvial deposits. The soils comprising the near-surface deposits along the pipeline consist of mixed sands, gravels, and clays derived during the Quaternary-Tertiary Period from ephemeral streams which eroded the Precambrian granite of the Userly Mountains and associated isolated hills. At the reservoir site, the near-surface deposits consist of alluvial/colluvial deposits, decomposed granite and weathered granite.

The Paradise-Queen Creek Valley is underlain by a deep, complex, structural basin (graben) which trends norhtwest. The basin is bounded on the east, near the project site, by a buried bedrock pediment. The topography of the pediment surface is irregular, as indicated by protruding bedrock outcrops (inselbergs) located near the pipeline and adjacent to the reservoir. Inspection of the local Bouguer gravity map and examination of structure contours constructed for the base of the alluvium suggest the following subsurface conditions:

- The rock pediment below the pipeline alignment and reservoir site may terminate about 2 miles southwest of the east end of the pipeline at a complex fault scarp, generally oriented northwest.
- A system of fault-bounded horsts and grabens and intersecting faults are located in the vicinity of the site. The concentration of hot water wells in the Buckhorn area, near the postulated fault intersections, is consistent with complex structure



control. Nevertheless, available data indicated that fault features have been inactive in recent periods.

- Details of the bedrock relief immediately below the pipeline alignment are unknown; however, the steep gradient of north-northwest trending structure contours below the site indicates the possible presence of secondary step-faults associated with the pediment margin or alternatively, a highly irregular bedrock topography.

Geologic Hazards: The east end of the pipeline is situated approximately 1.5 to 2 miles north of an area that has exhibited the development of earth fissures. Generally, total large-scale land subsidence in the area southeast of Buckhorn is estimated to be about 2 feet. Both earth fissures and land subsidence are related to the rapid water level declines that have occurred in recent years within alluvial sediments which overlie consolidated bedrock features.

In nearly all reported cases, earth fissures appear to form over or near subsurface fault scarps, bedrock protrusions or near surface bedrock discontinuities. It is at these locations that soils stresses are concentrated because of differential subsidence induced by large-scale water level declines. Because water level declines of as much as 350 feet have been reported by the U. S. Geological Survey in the area southeast of Buckhorn, the location of these earth fissures is consistent with the combined geologic and hydrologic conditions described.

It is estimated that the thickness of unconsolidated and semiconsolidated alluvial overburden along the pipeline alignment, except near station 78+00 and at the reservoir site, varies from approximately 100 to 400 feet. Near station 78+00 and the reservoir site,

alluvium is less than 50 feet thick. Because the closest part of the project is situated one-half mile or more outside the approximate boundary of the main water bearing unit, the potential for significant subsidence and/or incidence of earth fissure development along the project site does not appear likely.

Site reconnaissance during the field explorations did not indicate the presence of any subsidence or earth fissure features in the project area. Earth fissures initially appear as linear features usually less than one inch wide, and may be difficult to detect during the early stages of their development. Earth fissures typically become more noticeable when erosion caused by water draining into the fissures causes them to widen at the surface. The inspection of recent aerial photographs indicates no such features exist on the site.

Seismic activity affecting the area has been limited to minor shocks not related to geologic structures within or surrounding the Mesa/Phoenix valley. Therefore, the geologic hazard associated with anticipated seismic activity is considered minor.

At the reservoir site, the boulder roll-out potential is moderate from weathered boulders upslope from the site.

Site Conditions: At the time of our exploration, the pipeline site (north side of Brown Road and west side of Crismon) was a sandy shoulder of a paved road. The reservoir site was native desert. The ground surface in the reservoir sloped downward to east away from an adjacent granite hill. A wash crossed the eastern part of the site from north to south. The site contained a sparse growth of brush and cacti. Site drainage was to the wash.

SCOPE OF SERVICES

Eighteen borings (Borings 1 to 14 along the pipeline and Borings 15 to 18 at the reservoir site) were drilled to depths of 10 to 40 feet at the locations shown on the site plan. During exploration, subsoils were visually examined and sampled at selected intervals. Electrical resistivity tests were performed adjacent to Borings 1 to 14. Two refractive seismic traverses were performed at the reservoir site.

The following tests were performed on selected soil samples:

- Water content
- Dry density
- Shear Strength
- Gradation
- Plasticity

Test results were utilized in the development of foundation and earthwork recommendations.

INTERPRETATION OF SUBSURFACE CONDITIONS

Exploration: As presented on Logs of Borings, surface soils along the pipeline alignment to depths of 10 feet were found to be clayey sand with some areas of silty gravelly sand of medium density and low plasticity. These soils are slightly to heavily cemented. The surface soils at the reservoir site to depths of 1-1/2 to 12 feet are silty gravelly sands of medium density. The materials underlying the surface soils and extending to depths of 5 to 36 feet below existing grade consisted of very dense silty to clayey sands (decomposed granite) which is underlain by differentially weathered



granite. Refusal to auger penetration occurred in Borings 16, 17 and 18 on this granite deposit at depths of 23, 37.5 and 10 feet, respectively. A groundwater table was not encountered in any boring at the time of exploration. The results of the electrical resistivity tests are attached.

A refractive seismic survey consisting of 2 refractive seismic traverses was conducted on the site of the proposed reservoir. The seismic refraction method of field exploration consists of measuring (at known points along the surface of the ground) the travel time of compressional waves generated by an impulsive energy source and recorded by a detector (geophone). The field data recorded consists of time it takes the compressional wave to travel from the source to the detectors, and the distance between the detector and the source. This information is plotted and attached. The data is evaluated and interpreted using Snell's law to determine the approximate average compressional wave velocity. The approximate locations and orientations of the seismic traverses are depicted on the accompanying site plan.

As indicated on the attached "Results of Seismic Refraction Survey" sheets, average wave velocities of the near surface soils ranged from 675 to 2087 feet per second. The wave velocity in the underlying decomposed granite ranged from 4353 to 4685 feet per second.

Testing: Laboratory test results indicate that native subsoils along the pipeline exhibit moderate to high strength parameters.

CONCLUSIONS AND RECOMMENDATIONS

General: The recommendations presented in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the borings. If variations are encountered during construction, or if changes are made in site plan, structural loading, foundation type or reservoir bottom elevation, we should be notified for supplemental recommendations.

Water Pipeline:

- Excavation: Excavation to proposed pipeline grade in the lightly to moderately cemented soils may be readily accomplished with conventional excavation equipment. Excavations penetrating the heavily cemented soils may be slow and difficult to accomplish and may require the use of heavy-duty equipment using rippers.
- Slopes: The following tabulation presents estimated stable temporary slope conditions for the various soil types encountered, but are contingent upon relatively uniform soil conditions not subject to imposed conditions as outlined below. Steeper side slopes on excavations will require bracing.

<u>Material</u>	<u>Estimated Temporary Slopes</u>
Clayey Sand	1 to 3 (horizontal to vertical)
Silty Gravelly Sand	1 to 2 (horizontal to vertical)

The following items could also impose adverse effects on slope stability: (1) surface and/or subsoils in or adjacent to slopes becoming inundated or nearly saturated; (2) imposed loads adjacent to the slopes (heavy equipment, truck and rail traffic, soil spoil banks, construction materials stockpile, etc.); (3) close proximity of existing backfilled trenches, ditches, etc.



- Settlement: Since the subsidence potential in the area is low, differential settlements along the pipeline resulting from areal settling is minor.

Reservoir Site:

- Shallow Foundations: We recommend spread foundations bearing upon undisturbed decomposed granite and/or differentially weathered granite.

Alternative footing depths and design bearing capacities are presented in the following tabulation:

<u>Footing Depth Below Finished Grade (ft)</u>	<u>Design Bearing Capacity (psf)*</u>
1.0	10,000
1.5	12,000
2.0	15,000

*Design bearing capacities are predicated on foundations founded on the decomposed granite and/or differentially weathered granite.

Total or differential settlements resulting from the assumed loads are estimated to be less than 1/4 inch provided that foundations are constructed as recommended herein.

Little additional foundation movements will occur if water from any source infiltrates the foundation soils.

Finished grade is the lowest adjacent grade for perimeter footings. The design bearing capacities apply to dead loads plus design live load conditions. The design bearing capacity may



be increased by one-third when considering total loads that include wind or seismic. Recommended minimum widths of column and wall footings are 24 inches and 16 inches, respectively.

All footings, stem walls and walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations into undisturbed materials should be inspected by the geotechnical engineer. If the conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

- Lateral Earth Pressures: For soils above any free water surface, recommended equivalent fluid pressures and coefficients of base friction for unrestrained elements are:

- Active:
 - Undisturbed subsoil ----- 35 psf/ft
 - Compacted granular backfill ----- 30 psf/ft
 - Compacted site soils (non-clay) ----- 30 psf/ft
 - Undisturbed decomposed granite/granite - 15 psf/ft
- Passive:
 - Shallow wall footings in soil ----- 300 psf/ft
 - Shallow wall footings in
decomposed granite/granite ----- 900 psf/ft
- Coefficient of base friction ----- 0.45*

*The coefficient of base friction should be reduced to 0.35 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:



- At-rest:

- Undisturbed subsoil ----- 60 psf/ft
- Compacted granular backfill ----- 55 psf/ft
- Undisturbed decomposed granite/granite - 30 psf/ft

The lateral earth pressures presented herein are not applicable for submerged soils. We should be consulted for additional recommendations if such conditions are to be included in the design.

Fill against footings, stem walls, subsurface walls and retaining walls should be compacted to densities specified in "Earthwork." Medium to high plasticity clay soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause excessive lateral earth pressures which could result in wall movements.

- Earthwork:

- General:

1. The conclusions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section.

- Site Clearing:

1. Strip and remove existing vegetation, boulders and other deleterious materials from the reservoir area. All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.



- Excavation:

1. We anticipate that excavations penetrating the surface soils can be accomplished with conventional equipment. According to the Caterpillar Tractor Company in the January, 1983 edition of (Handbook of Ripping," the wave velocities in the decomposed granite are within the ranges considered rippable by D8L, D9L, or D10L using rippers on Caterpillar equipment. Some zones may require removal with pneumatic equipment and/or blasting. Excavations penetrating the differentially weathered granite will require heavy-duty equipment assisted by pneumatic equipment. Blasting may be required. Small or narrow excavations will be more difficult to excavate.

- Foundation Preparation:

1. Specialized treatment of existing soils within foundation areas is not required.

- Materials:

1. Clean on-site or imported materials may be used as backfill material.
2. Imported soils should conform to the following:



- Gradation (ASTM C136):
 percent finer by weight

6"	100
4"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	60-(max)
- Maximum expansive potential(%)* 1.5
- Maximum soluble sulfates(%) 0.10

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

3. Aggregate base should conform to Maricopa Association of Government (MAG) specifications.

- Placement and Compaction:

1. Place and compact fill in horizontal lifts using equipment and procedures that will produce recommended water contents and densities throughout the lift.
2. Materials should be compacted to the following:

<u>Material</u>	<u>Minimum Percent Compaction (ASTM D698)</u>
On-site soils, reworked and fill:	
Against subsurface wall-----	95
Imported fill:	
Against subsurface wall-----	95
Aggregate base-----	95
Miscellaneous backfill-----	90



3. On-site and imported soils should be compacted within a moisture range of 3 percent below to 3 percent above optimum.

- Conformance:

1. Recommendations for lateral earth pressures are dependent upon conformance to "Earthwork" recommendations. To assess compliance with these recommendations, observation and testing should be performed under the direction of a geotechnical engineer.

Drainage:

- Surface Drainage:

1. Positive drainage should be provided during construction and maintained throughout the life of the proposed development. Infiltration of water into utility or foundation excavations must be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the building should be eliminated.
2. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with an outfall of approximately 4 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration.



● Drainage Behind Walls:

1. If subsurface walls are not designed to withstand hydrostatic pressures, a drainage system consisting of perforated drain lines (placed near the base of the wall) should be used to intercept and discharge water which would tend to saturate the backfill. Where used, drain lines should be embedded in a uniformly graded filter material and provided with adequate clean-outs for periodic maintenance. An impervious soil should be utilized in the upper layer of backfill to reduce the potential for water infiltration.

Ancillary Features:

● Exterior:

1. Exterior slabs-on-grade, exterior architectural features and utilities founded on or in backfill may experience some movement due to the volume change of the backfill. Reduction of potential movement could be realized by:
 - minimizing moisture increases in the backfill
 - moisture-density control during placement of backfill
 - use of designs which allow vertical movement between the exterior features and adjoining structural elements
 - placement of effective control joints on relatively close centers
 - allowance for vertical movements in utility connections



CLOSURE

Our conclusions and recommendations are predicated on observation and testing of the earthwork and foundation preparations directed by a geotechnical engineer. It would be logical for Western Technologies Inc. to provide these services since we are most qualified to determine consistency of field conditions with those data used in our analyses.

Deviations from our recommendations by the plans, written specifications or field applications shall relieve us of responsibility unless our written concurrence with such deviations has been obtained.

DEFINITION OF TERMINOLOGY

ALLOWABLE SOIL BEARING CAPACITY ALLOWABLE FOUNDATION PRESSURE	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
BACKFILL	A specified material placed and compacted in a confined area.
BASE COURSE	A layer of specified material placed on a subgrade or subbase.
BASE COURSE GRADE	Top of base course.
BENCH	A horizontal surface in a sloped deposit.
CAISSON	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
CONCRETE SLABS-ON-GRADE	A concrete surface layer cast directly upon a base, subbase or subgrade.
CRUSHED ROCK BASE COURSE	A base course composed of crushed rock of a specified gradation.
DIFFERENTIAL SETTLEMENT	Unequal settlement between or within foundation elements of a structure.
ENGINEERED FILL	Specified material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
EXISTING FILL	Materials deposited through the action of man prior to exploration of the site.
EXISTING GRADE	The ground surface at the time of field exploration.
EXPANSIVE POTENTIAL	The potential of a soil to expand (increase in volume) due to the absorption of moisture.
FILL	Materials deposited by the action of man.
FINISHED GRADE	The final grade created as a part of the project.
GRAVEL BASE COURSE	A base course composed of naturally occurring gravel with a specified gradation.
HEAVE	Upward movement.
NATIVE GRADE	The naturally occurring ground surface.
NATIVE SOIL	Naturally occurring on-site soil.
ROCK	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
SAND AND GRAVEL BASE	A base course of sand and gravel of a specified gradation.
SAND BASE COURSE	A base course composed primarily of sand of a specified gradation.
SCARIFY	To mechanically loosen soil or break down existing soil structure.
SETTLEMENT	Downward movement.
SOIL	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
STRIP	To remove from present location.
SUBBASE	A layer of specified material placed to form a layer between the subgrade and base course.
SUBBASE GRADE	Top of subbase.
SUBGRADE	Prepared native soil surface.



METHOD OF SOIL CLASSIFICATION (ASTM D 2487)

COARSE-GRAINED SOILS

LESS THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	
SM	SILTY SANDS, SAND-SILT MIXTURES, MORE THAN 12% FINES	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	

NOTE:

Coarse grained soils receive dual symbols if they contain 5 to 12% fines (e.g. SW-SM, GP-GC, etc.)

FINE-GRAINED SOILS

MORE THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS Liquid limit less than 50
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
OL	ORGANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY	
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit more than 50
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
PT	PEAT, MUCK, AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE:

Fine grained soils receive dual symbols if their limits plot in the hatched zone on the Plasticity Chart (ML-CL)

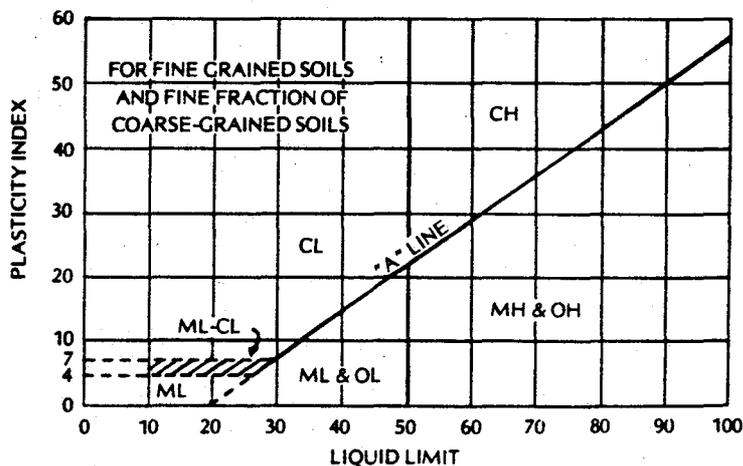
SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 in.
COBBLES	3 in. to 12 in.
GRAVEL	No. 4 to 3 in.
Coarse	¾ in. to 3 in.
Fine	No. 4 to ¾ in.
SAND	No. 200 to No. 4
Coarse	No. 10 to No. 4
Medium	No. 40 to No. 10
Fine	No. 200 to No. 40
* FINES (Silt or Clay)	BELOW No. 200

NOTE:

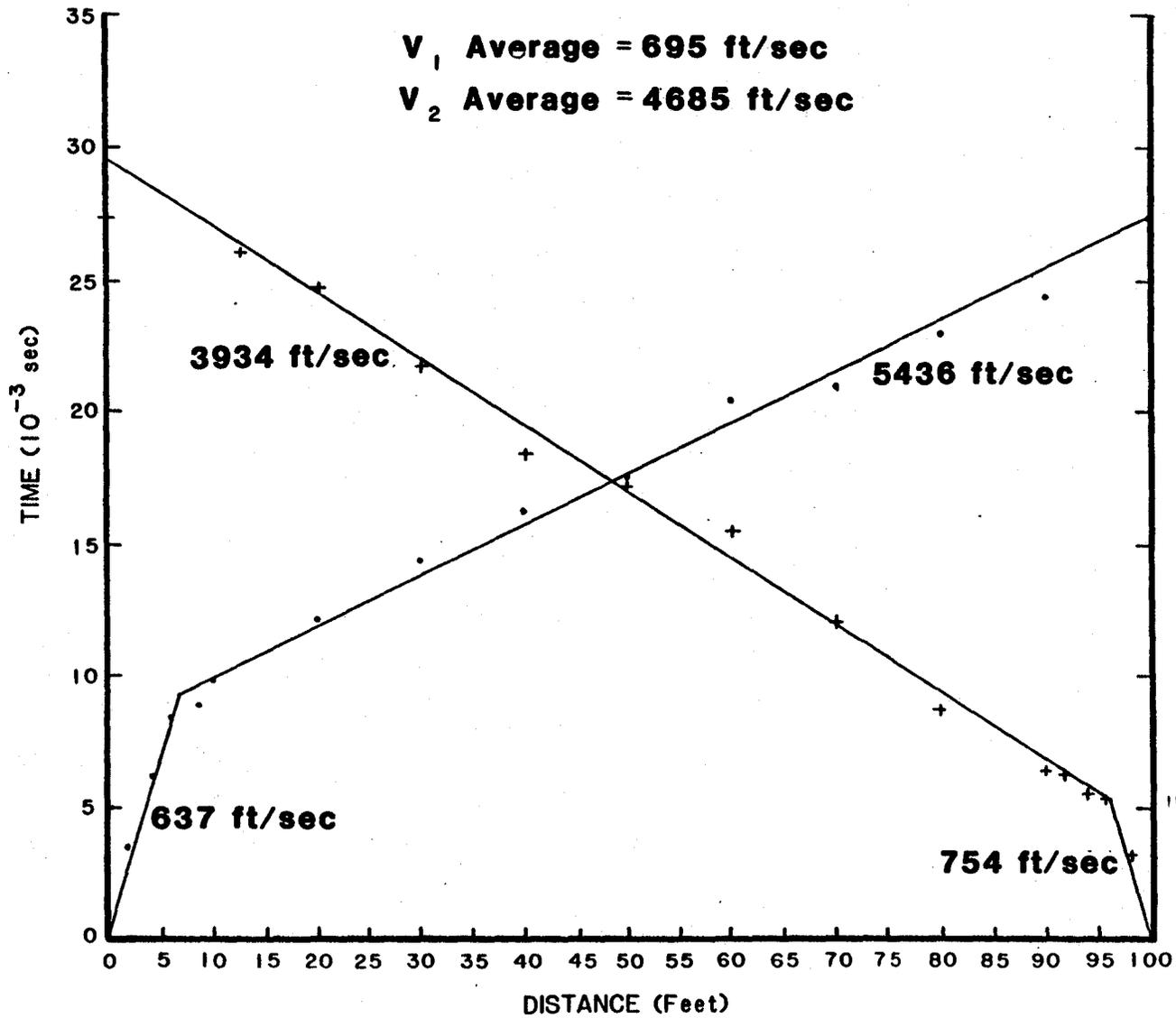
Only sizes smaller than three inches are used to classify soils.

PLASTICITY CHART



JOB NO. 2124J230

Results of Seismic Refraction Survey Line # 1

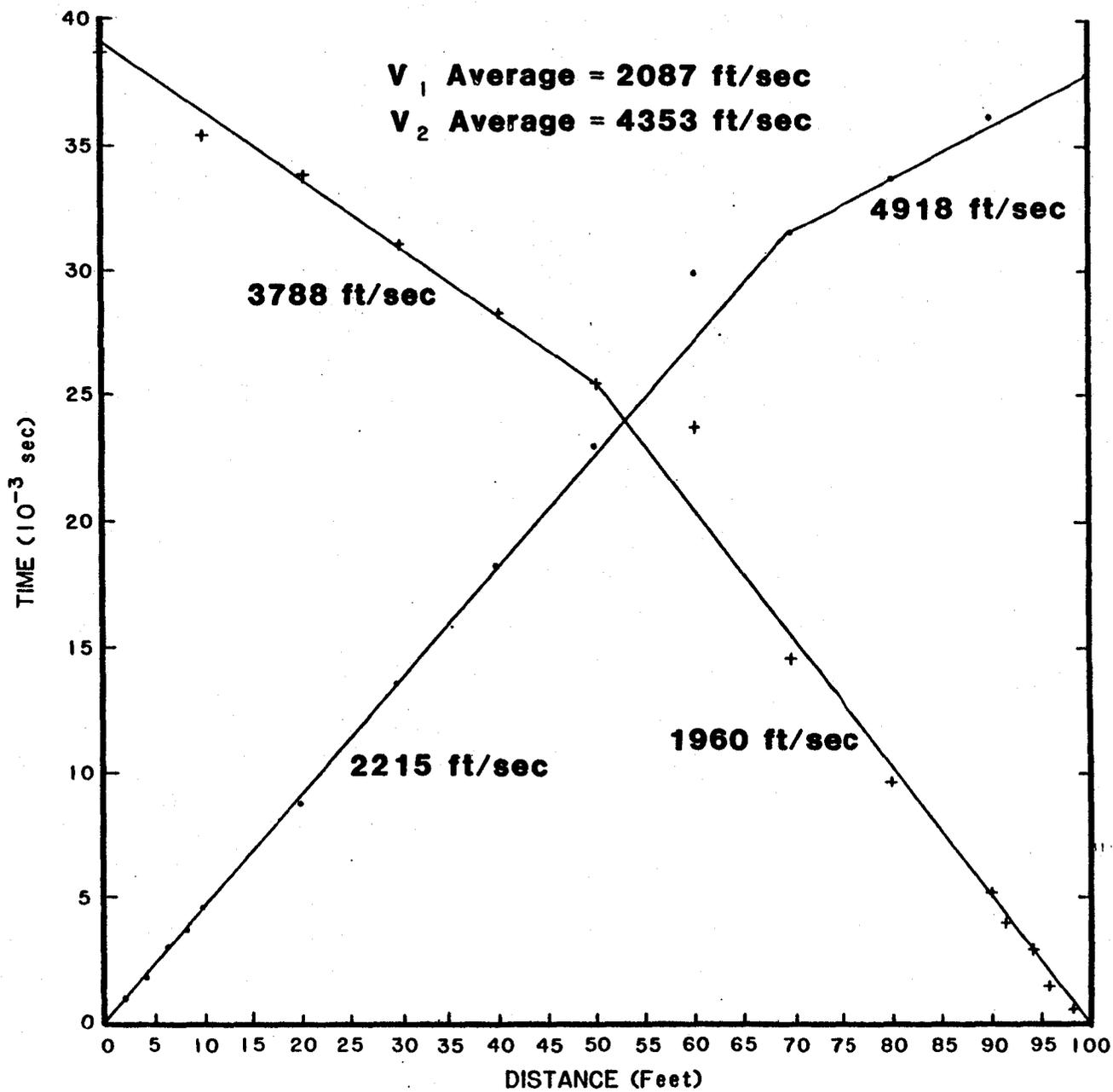


A-5



JOB NO. 2124J230

Results of Seismic Refraction Survey Line #2



9-V



RESISTIVITY TESTS

<u>Boring No.</u>	<u>Station</u>	<u>Probe Spacing (ft)</u>	<u>Resistivity*</u> <u>(ohm-cm)</u>
1	12+00L25	10	5132.2
2	25+20L25	10	3351.2
3	44+00L25	10	4002.4
4	51+60L25	10	4385.4
5	64+80L25	10	4959.8
6	78+00L25	10	6013.1
7	86+00L25	10	5859.9
8	105+20L25	10	4825.8
9	118+40L25	10	5419.4
10	131+60L25	10	5208.8
11	144+80L25	10	4308.8
12	158+00L25	10	7449.4
13	171+20L25	10	7449.4
14	184+40L25	10	6874.8

*Four probe Wenner method



BORING LOG NOTES

The number shown in "LOG OF BORING NO." refers to the approximate location of the same number indicated on the "Site Plan" as positioned in the field by pacing from property lines and/or existing features.

"STA" refers to the approximate stationing of the boring along the proposed alignment.

"R" or "L" refers to the approximate lateral offset, right or left, respectively, from the centerline of the existing roads.

"TYPE/SIZE BORING" refers to the exploratory equipment used in the boring wherein HSA = hollow-stem auger.

"N" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a two-inch-outside-diameter split-barrel sampler a distance of 1 foot, Standard Penetration Test (ASTM D1586). Refusal to penetration is considered more than 100 blows per foot.

"R" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a 2.42-inch-inside-diameter ring sampler a distance of 1 foot. Refusal to penetration is considered more than 50 blows per foot.

"Sample Type" refers to the form of sample recovery wherein N = Split-barrel sample, R = Ring sample and G = Grab sample.

"Dry Density, pcf" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol "NR" indicates that no sample was recovered. The symbol "*" indicates that determination of dry density was not possible.

"Moisture Content, %" refers to the laboratory-determined moisture content in percent (ASTM D2216).

"Unified Class" refers to the soil type as defined by "Method of Soil Classification". The soils were visually classified in the field and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate test.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans or as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

In general, terms and symbols on the boring logs conform with "Standard Definitions of Terms and Symbols Relating to Soil and Rock Mechanics" (ASTM D653).



LOG OF BORING NO. 1

Sta. 12+00 L 45'

Job No. 2124J230

Project Pipeline and Reservoir

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/10/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		50/9"	R	100	4.4	SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Light to moderate cementation below 3 feet
10			G				
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 2

Sta. 25+20 L 45'

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined

Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/10/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		50/6"	G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Light to moderate cementation below 4 feet
10			R	NR			Stopped @ 10 feet
15							
20							
25							
30							



LOG OF BORING NO. 3

Sta. 44+00

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined

Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/10/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description =
	C	N/R					
5			G				
		33	R	119	1.0	SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp
10							Moderate to heavy cementation
							Stopped @ 10 feet
15							
20							
25							
30							



LOG OF BORING NO. 3
Sta. 44+00

Project Pipeline and Reservoir Job No. 2124J230
Elevation Not Determined Datum _____
Type/Size Boring 7" HSA Rig Type CME 75 Date 9/10/84
Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		33	G	R 119	1.0	SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp
10							Moderate to heavy cementation
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 4
Sta. 51+60

Project Pipeline and Reservoir Job No. 2124J230
 Elevation Not Determined Datum _____
 Type/Size Boring 7" HSA Rig Type CME 75 Date 9/10/84
 Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Some gravel Light cementation Moderate to heavy cementation
10		50/6"	R	NR			Stopped @ 10 feet
15							
20							
25							
30							



LOG OF BORING NO. 5

Sta. 64+80 L 50'

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Trace gravel Light cementation
10		50/6"	R NR				
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 6

Sta. 78+00 L 50'

Project Pipeline and Reservoir Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Moderate cementation Very heavy cementation
10		50/2"	R	NR			Stopped @ 10 feet
15							
20							
25							
30							



LOG OF BORING NO. 7

Sta. 86+00 L 50' (Approx.)

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		50/8"	R	84	2.3	SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Light to moderate cementation
10			G				
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 8
 Sta. 105+20 L 30'

Project Pipeline and Reservoir Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Moderate cementation
		50/2"	R	NR			
			G				
10							Stopped @ 10 feet
15							
20							
25							
30							



LOG OF BORING NO. 9

Sta. 118+40 L 40'

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined

Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp
		50/5"	R	NR			Light cementation
10		50/4"	R	NR			Moderate to heavy cementation
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 10

Sta. 131+60 L 25'

Project Pipeline and Reservoir Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Some gravel Light cementation Moderate cementation
10		50/4"	R	*	4.7		
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 11

Sta. 144+80 L 12'

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		15	R	115	2.4	SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Light cementation
10			G				
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 12

Sta. 158+00 L 30'

Project Pipeline and Reservoir Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		18	R	115	2.2	SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Light cementation
10			G				Moderate cementation
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 13

Sta. 171+20 L 30'

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/13/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SC	CLAYEY SAND; some silt, brown, medium dense, slightly damp Light cementation
10		50/11"	R	119	6.2		
15							Stopped @ 10 feet
20							
25							
30							



LOG OF BORING NO. 14

Sta. 184+40 L 20'

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined

Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/11/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5			G			SM	SILTY GRAVELLY SAND; trace clay, brown, dense, slightly damp
10		42	R	117	2.7		
15							Stopped @ 10 feet
20							
25							
30							



Project Pipeline and Reservoir (Reservoir Site) Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/11/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5						SM	SILTY GRAVELLY SAND; trace clay, brown, dense, slightly damp
10		120/9"	N			SM/SC	SILTY TO CLAYEY SAND; brown, very dense to hard, slightly damp, (decomposed granite)
		137/10"	N				
20		75/6"	N				GRANITE; differentially weathered (weathered to highly weathered), fractured, brown to gray, hard to very hard Harder with depth
		75/3"	N	NR			
25		75/1"	N	NR			
30							



LOG OF BORING NO. 15 CONTINUED
 (Reservoir Site)

Project Pipeline and Reservoir

Job No. 2124J230

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
31							GRANITE; (Con't) Less weathered granite
35							
40							
							Stopped @ 40 feet
45							
50							
55							
60							



LOG OF BORING NO. 16

(Reservoir Site)

Project Pipeline and Reservoir

Job No. 2124J230

Elevation Not Determined

Datum _____

Type/Size Boring 7" HSA

Rig Type CME 75

Date 9/11/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
						SM	SILTY GRAVELLY SAND; trace clay, brown, dense, slightly damp
5		75/3"	N			SM/SC	SILTY TO CLAYEY SAND; brown, very dense to hard, slightly damp, (decomposed granite)
10		75/3"	N				
15		75/2"	N				
20		75/1"	N	NR			GRANITE; differentially weathered (weathered to highly weathered), fractured, brown to gray, hard to very hard
25							Refusal @ 23 feet on granite bedrock
30							



LOG OF BORING NO. 17

Project Pipeline and Reservoir (Reservoir Site) Job No. 2124J230

Elevation Not Determined Datum _____

Type/Size Boring 7" HSA Rig Type CME 75 Date 9/11/84

Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
5		16				SM	SILTY GRAVELLY SAND; trace clay, brown, dense, slightly damp
10		42					
15		50/2"	R NR			SM/ SC	SILTY TO CLAYEY SAND; brown, very dense to hard, slightly damp, (decomposed granite)
20		123/9"	N				
25		25/0"	N NR				
30							



Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
31		75/3"	N			SM/ SC	SILTY TO CLAYEY SAND; (Con't)
35		75/1"	N	NR			
							GRANITE; differentially weathered (weathered to highly weathered), fractured, brown to gray, hard to very hard Refusal @ 37.5 feet on granite bedrock
40							
45							
50							
55							
60							



LOG OF BORING NO. 18

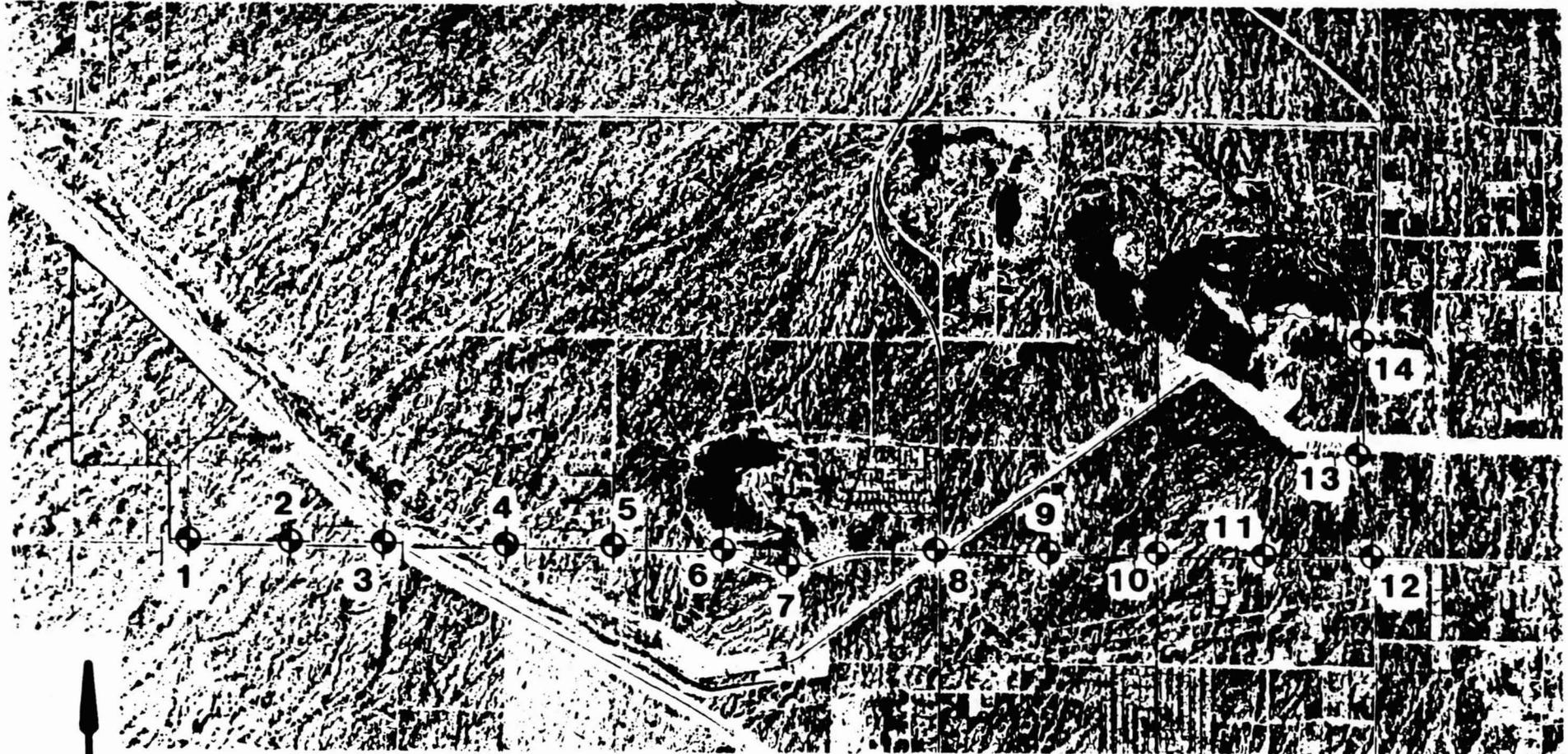
Project Water Pipeline and Reservoir (Reservoir Site) Job No. 2124J230
 Elevation Not Determined Datum _____
 Type/Size Boring 7" HSA Rig Type CME 75 Date 10/19/84
 Groundwater Conditions None Encountered

Depth, feet	Blows/Foot		Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
	C	N/R					
0						SM	SILTY GRAVELLY SAND; trace clay, brown, dense, slightly damp
1						SM/SC	SILTY TO CLAYEY SAND; brown, very dense to hard, slightly damp, (decomposed granite)
5		100/3"	N	NR			GRANITE; differentially weathered (weathered to highly weathered), fractured, brown to gray, hard to very hard
10							Refusal @ 10 feet on granite bedrock
15							
20							
25							
30							



JOB NO. 2124J230
REFERENCE: AERIAL PHOTO, NOT DATED

Site Plan



 TEST BORING LOCATION

A-29



JOB NO. 2124J230

REFERENCE: MESA ENGINEERING DEPT. PLAN, NOT DATED

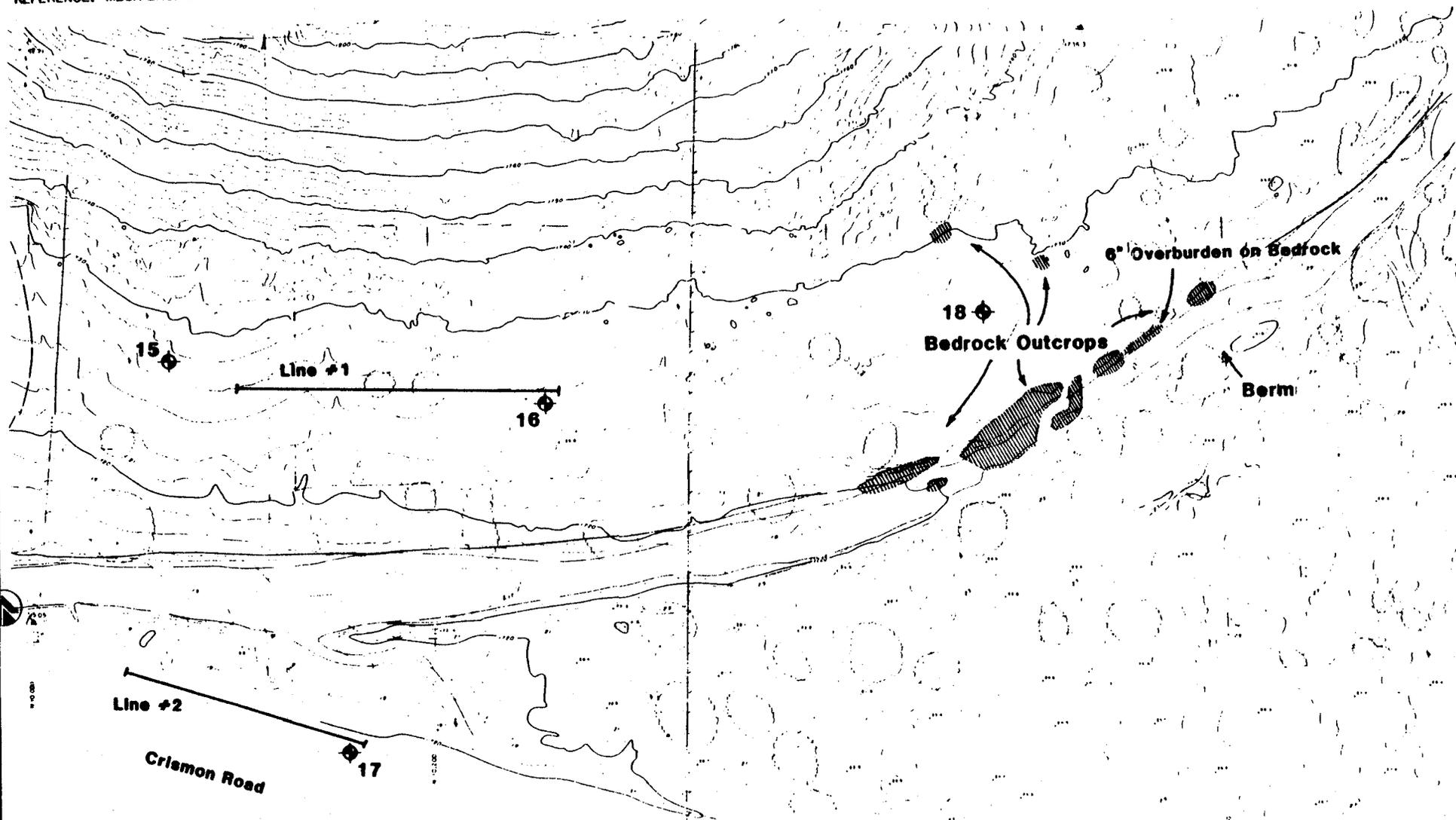
SITE PLAN

Date

Checked By

Date 10/15/84

Prepared By SDV



SEISMIC REFRACTION SURVEY LINE

TEST BORING LOCATION

