

SPECIAL PROVISIONS  
for  
7TH STREET BRIDGE AND UTILITY RELOCATIONS  
at the  
ARIZONA CANAL DIVERSION CHANNEL  
CONTRACT NO. FCD 88-24  
July 1988

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SPECIAL PROVISIONS  
FOR  
7TH STREET BRIDGE AND UTILITY RELOCATIONS  
AT THE  
ARIZONA CANAL DIVERSION CHANNEL

CONTRACT NO. FCD 88-24

July 1988



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

ATTENTION  
ALL PROSPECTIVE BIDDERS

Some of the Bid Bonds previously received with bids for Flood Control District construction projects have not been in complete compliance with Arizona Revised Statutes (ARS).

ARS 34-201-A3 requires that every bid be accompanied by a certified check, cashier's check or surety bond for five percent (5%) of the amount of the bid.

In some cases the bonds limit the five percent (5%) to the difference between the low bid and that of the next lowest responsible bidder, to whom a contract could be awarded, in the event that the low bidder failed to enter into contract within the specified time.

Bids received with limitation on the five percent (5%) will be considered as non-responsive bids and will not be accepted or considered for award of contract.

The SURETY BOND form contained in the M.A.G. specifications or a similar form must be used for bids to be acceptable to the Flood Control District.

Please take note and submit your bids accordingly.

Any Bid Bond submitted with the wording, or similar wording, as underlined in the following paragraph will be considered unacceptable.

SAMPLE OF LIMITATION IN UNACCEPTABLE BID BOND

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or contract documents with good and sufficient surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
CONTRACT FCD 88-24

TABLE OF CONTENTS:

1. Invitation for Bids
2. Bid Form
3. Bid Bond Form
4. No Collusion Affidavit
5. Construction Special Provisions and Standard Details
6. Contract
7. Statutory Payment Bond
8. Statutory Performance Bond
9. Certificate of Insurance
10. Drawings:
  - 1) Seventh Street Bridge and Utility Relocations  
at the Arizona Canal Diversion Channel  
Sheets 1 through 28 of 28
  - 2) Sewer Relocations - Central Avenue to 7th Street  
for the Arizona Canal Diversion Channel  
Sheets 1 through 8 of 8
  - 3) Water Relocation - Central Ave., 1st St. & Butler  
Dr. for the Arizona Canal Diversion Channel  
Sheets 1 through 4 of 4

INVITATION FOR BIDS  
(Construction Contract)

Project: 7th Street Bridge and  
Utility Relocations  
at the ACDC

Ref. Invitation FCD 88-24  
Date: July 6, 1988  
Issued by: Flood Control District  
of Maricopa County

Vicinity: 7th Street and Griswold  
Road, and Las Palmaritas,  
Central Avenue to 7th  
Street along the Arizona  
Canal, Phoenix, Arizona

SEALED BIDS, IN SINGLE COPY FOR THE WORK DESCRIBED HEREIN WILL BE RECEIVED UNTIL 2:00 P.M., LOCAL TIME AT THE PLACE OF THE BID OPENING AUGUST 4, 1988, IN THE OFFICE OF THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, 3335 WEST DURANGO STREET, PHOENIX, ARIZONA, 85009, AND AT THAT TIME PUBLICLY OPENED.

A PRE-BID CONFERENCE WILL BE HELD ON JULY 18, 1988, AT 2:00 P.M. IN THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY CONFERENCE ROOM, 3335 WEST DURANGO STREET. IT IS IN THE BEST INTEREST OF PROSPECTIVE BIDDERS TO ATTEND THE PRE-BID CONFERENCE.

BID SECURITY IN AN AMOUNT OF NOT LESS THAN FIVE PERCENT (5%) OF THE TOTAL BID PRICE MUST BE SUBMITTED WITH EACH BID. THE BID SECURITY MAY BE IN THE FORM OF A BID BOND, CASHIER'S CHECK, POSTAL MONEY ORDER, OR CASH. THE BID SECURITY WILL BE MADE PAYABLE TO THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY AS A GUARANTEE THAT IF THE WORK IS AWARDED TO THE BIDDER, HE WILL WITHIN TEN (10) DAYS FROM THE DATE OF SUCH AWARD, ENTER INTO PROPER CONTRACT AND BOND CONDITIONS FOR THE FAITHFUL PERFORMANCE OF THE WORK. OTHERWISE, SAID AMOUNT WILL BE FORFEITED TO THE FLOOD CONTROL DISTRICT. BID SECURITY WILL BE RETURNED AS PRESCRIBED BY MAG 103.

THE SUCCESSFUL BIDDER SHALL BE REQUIRED TO FURNISH PERFORMANCE AND PAYMENT BONDS IN PENAL SUMS NOT LESS THAN ONE HUNDRED PERCENT (100%) RESPECTIVELY, OF THE ORIGINAL AMOUNT OF THE CONTRACT.

DESCRIPTION OF WORK:

Construction of a bridge and underpass in two phases at 7th Street north of the Arizona Canal; construction of a sewer lift station and 10" force main; relocation of utilities including 10" and 12" sewer lines, 12" water line, 12" and 42" storm drains; construction of concrete curb and gutter and A.C. pavement; demolition of existing structures including removal of buried fuel and waste oil tanks; and other miscellaneous related work.

INVITATION FOR BIDS  
NO. FCD 88-24

THE WORK SHALL COMMENCE WITHIN SEVEN (7) CALENDAR DAYS AND BE COMPLETED WITHIN TWO HUNDRED TEN (210) CALENDAR DAYS AFTER RECEIPT OF THE NOTICE TO PROCEED.

NOTICE: THE BID SCHEDULE, SPECIAL PROVISIONS, INSTRUCTIONS TO BIDDERS, UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, EDITION OF 1979 (MAG) AND DRAWINGS LISTED UNDER THE CONTENTS WILL BE INCORPORATED IN AND BECOME A PART OF THE RESULTANT CONTRACT.

CHERIE PENNINGTON, CLERK  
BOARD OF DIRECTORS  
FLOOD CONTROL DISTRICT OF  
MARICOPA COUNTY

INVITATION FOR BIDS  
NO. FCD 88-24

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
INVITATION FOR BIDS, FCD 88-24  
INSTRUCTIONS TO BIDDERS

1. Explanation to Bidders. Any explanations desired by the bidder, questions, or items for clarification regarding the meaning or interpretation of the invitation for bids, drawings, specifications, etc., may be addressed to the Chief Engineer and General Manager, preferably in writing, prior to the pre-bid conference. Any answers, interpretations, or clarifications affecting the cost will be addressed to all bidders in an addendum to the invitation. The receipt of an addendum by the bidder must be acknowledged in the space provided on the bid form or by letter or telegram received before the time set for the bid opening. Oral explanations or instructions given before the award of the contract will not be binding.
2. Conditions Affecting the Work. It is in the best interest of the bidders to attend the pre-bid conference. Bidders should visit the site and take such other steps as may be reasonably necessary to ascertain the nature and the location of the work, the general and local conditions which can affect the work and the cost thereof. Failure to do so will not relieve bidders from responsibility for estimating properly the difficulty or cost of successfully performing the work. (See MAG 102.4)
3. Bidder's Qualifications. Before a bid is considered for award, a bidder may be requested by the Chief Engineer and General Manager of the Flood Control District to submit a statement regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work.
4. Bid Guarantee. Where a bid guarantee is required by the invitation for bids, failure to furnish a bid guarantee in the proper form and amount by the time set for opening of bids, may be cause for rejection of the bid.

If the successful bidder, upon acceptance of his bid by the Flood Control District within the period specified herein for acceptance (sixty days if no period is specified) fails to execute such further contractual documents, if any, and give such bond(s) as may be required by the terms of the bid as accepted within the time specified (ten days if no period is specified) after receipt of the forms by him, his contract may be terminated for default. In such event the bid guarantee shall be retained as liquidated damages.

INVITATION FOR BIDS  
NO. FCD 88-24

5. Preparation of Bids. Bids shall be submitted on the forms furnished, or copies thereof, and must be manually signed. If erasures or other changes appear on the forms, each erasure or change must be initialed by the person signing the bid. Unless specifically authorized in the invitation for bids, telegraphic bids will not be considered.

No bid will be considered unless all items in the bid schedule are priced. In case of an error in the extension of price, the unit price shall govern. The quantities listed on the bid schedule on which unit prices are requested are estimates only.

Unless called for, alternate bids will not be considered.

Modifications of bids already submitted will be considered if received at the office designated in the invitation for bids by the time set for opening bids.

6. Submission of Bids. Bids must be sealed, addressed to the Chief Engineer and General Manager, Flood Control District of Maricopa County, 3335 West Durango, Phoenix, Arizona 85009, and marked to identify the bid to the referenced Contract FCD Number. Failure to appropriately identify the bid may result in a premature opening of, or a failure to open, such bid. The name of the bidder shall be on the outside of the envelope. (See MAG 102.9)
7. Withdrawal of Bids or Modifications. Bids may be withdrawn by written request received from the bidder prior to the time set for opening of bids.
8. Public Opening of Bids. Bids will be publicly opened at the time and place set for the opening in the invitation for bids. Their content will be made public for the information of bidders and others interested, who may be present either in person or by representative.
9. Award of Contract. Award and execution of a contract shall be in accordance with MAG Section 103.
10. Specifications. Specifications referred to herein shall include all revisions and amendments in effect on the date of issuance of the invitation for bids. These instructions, Special Instructions to Bidders, and the herein contained Construction Special Provisions supplement the Uniform Standard Specifications herein referred to by "MAG" section number or paragraph number; however, in case of conflict, these instructions and Special Provisions supersede the Uniform Standard Specifications (MAG).

INVITATION FOR BIDS  
NO. FCD 88-24

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
 INVITATION FOR BIDS, FCD 88-24  
 SPECIAL INSTRUCTIONS TO BIDDER

Contract Plans, Special Provisions and Contract Documents: Plans, Special Provisions, and forms for proposal, Bidding Schedule, Contract Agreement and Performance Bond may be obtained from the Flood Control District of Maricopa County, 3335 West Durango Street, Phoenix, Arizona, upon payment of \$30.00 by check payable to the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY. This payment will not be refunded.

APPROXIMATE QUANTITIES FOR PRINCIPAL ITEMS

| <u>QUANTITY</u> | <u>UNIT</u> | <u>DESCRIPTION</u>           |
|-----------------|-------------|------------------------------|
| 1238            | LF          | 30" Drilled Shaft Foundation |
| 590             | LF          | 42" Drilled Shaft Foundation |
| 695             | CY          | Class "A" Concrete           |
| 64925           | LB          | Steel Reinforcement          |
| 20              | EACH        | Precast Concrete Box Girders |
| 2700            | SF          | Concrete Sidewalk            |
| 1298            | LF          | Curb and Gutter              |
| 2               | EACH        | Cul-de-sacs                  |
| 1               | LS          | Sewer Lift Station           |
| 1260            | SF          | Concrete Block Masonry       |
| 364             | LF          | 10" Force Main               |
| 172             | LF          | 8" VCP Sewer Line            |
| 3690            | LF          | 10" VCP Sewer Line           |
| 330             | LF          | 12" VCP Sewer Line           |
| 570             | LF          | 6" Water Line                |
| 146             | LF          | 8" DIP Water Line            |
| 899             | LF          | 12" DIP Water Line           |
| 280             | LF          | 12" RCP Storm Drain          |
| 178             | LF          | 42" RGRCP Storm Drain        |
| 1               | LS          | Miscellaneous Removals       |

and such other pertinent items as are necessary for the completion of the project as shown on the plans or as called for in the Special Provisions or in the Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction.

Location of Work: The proposed work is located in the vicinity of 7th Street and Griswold Road, north of the Arizona Canal, and along Las Palmaritas Drive from Central Avenue to 7th Street, Phoenix, Arizona.

CHERIE PENNINGTON, CLERK  
 BOARD OF DIRECTORS  
 FLOOD CONTROL DISTRICT OF  
 MARICOPA COUNTY

INVITATION FOR BIDS  
 CONTRACT NO. FCD 88-24

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
(Construction Contract)

BID FORM

Project: 7th Street Bridge and Utility  
Relocations at the ACDC

Invitation FCD 88-24  
Date: July 6, 1988

Location: 7th Street and Griswold Road,  
and Las Palmaritas, Central Avenue  
to 7th Street along the Arizona  
Canal, Phoenix, Arizona

To: Chief Engineer and General Manager  
Flood Control District of Maricopa County  
3335 West Durango Street  
Phoenix, Arizona 85009

The following Proposal is made on behalf of \_\_\_\_\_  
\_\_\_\_\_ and no others. The Total Contract amount of

this proposal is (in words) \_\_\_\_\_

\_\_\_\_\_ and \_\_\_\_\_/100 dollars, (in figures)

\_\_\_\_\_, this amount being the sum total of the extended  
amount for each pay item on the Bidding Schedule.

Evidence of authority to submit the Proposal is herewith furnished. The Proposal is in all respects fair and is made without collusion on the part of any person, firm, or corporation mentioned above, and no member or employee of the Flood Control District Board of Directors is personally or financially interested, directly or indirectly in the Proposal, or in any purchase or sale of any materials or supplies for the work in which it relates or in any portion of the profits thereof.

The Undersigned certifies that the approved Plans, Uniform Standard Specifications for Public Works Construction, 1979 Edition (MAG) and revisions and supplements thereto, together with the Special Provisions, forms of Contract and Bond authorized by the Board of Directors and constituting essential parts of this Proposal, have been carefully examined, and also that the site of the work has been personally inspected.

The Undersigned declares that the amount and nature of the work to be done is understood and that at no time will misunderstanding of the Plans, Specifications, Special Provisions, or conditions to be overcome, be pled. On the basis of the Plans, Specifications, Special Provisions, the forms of Contract, and the Bond proposed for use, the Undersigned proposes to furnish

PROPOSAL  
CONTRACT FCD 88-24

all the necessary machinery, equipment, tools, apparatus, and other means of construction, to do all the work and to furnish all the materials in the manner specified and to finish the entire project within the time hereinafter proposed and to accept, as full compensation therefor, the sum of various products obtained by multiplying each unit price, herein bid for work or materials, by the quantity thereof actually incorporated in the completed project, as determined by the Chief Engineer and General Manager, Flood Control District of Maricopa County.

The Undersigned understands that the quantities mentioned herein are approximate and are subject to increase or decrease and hereby proposes to perform all quantities of work, as either increased or decreased, in accordance with the provisions of the Specifications, at the unit price bid in the Bidding Schedule.

PROPOSAL  
CONTRACT FCD 88-24

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

Page BS-1

| Item No. | Approximate Quantity | Unit | Description                                 | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|---|---|-----------|-----------------|
| 206-1    | 2,250                | CY   | Structural Excavation Bridge & Lift Station |   |           |                 |
| 206-2    | 838                  | CY   | Structural Backfill Bridge & Lift Station   |   |           |                 |
| 211-1    | 1,161                | CY   | Fill Construction                           |   |           |                 |
| 301-1    | 2,650                | SY   | Subgrade Preparation                        |   |           |                 |
| 310-1    | 928                  | CY   | Aggregate Base Course                       |   |           |                 |
| 315-1    | 3                    | TON  | Bituminous Prime Coat                       |   |           |                 |
| 321-1    | 108                  | TON  | A-1 1/2" Asphaltic Concrete                 |   |           |                 |
| 321-2    | 547                  | TON  | C-3/4" Asphaltic Concrete                   |   |           |                 |
| 324-1    | 180                  | SY   | Portland Cement Concrete Pavement           |   |           |                 |
| 340-1    | 618                  | LF   | Curb & Gutter (H = 6") (Detail 220, Type A) |   |           |                 |
| 340-2    | 463                  | LF   | Roll Type Curb & Gutter (Type C)            |   |           |                 |
| 340-3    | 217                  | LF   | Single Curb (Detail 222, Type B)            |   |           |                 |
| 340-4    | 2,700                | SF   | Sidewalk (Detail P-1230)                    |   |           |                 |

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

Page BS-2

| Item No. | Approximate Quantity | Unit | Description  | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|--|---|-----------|-----------------|
| 340-5    | 60                   | SF   | Sidewalk Ramp (Detail P-1236, Type D)                              |   |           |                 |
| 350-1    | 1                    | LS   | Demolish & Remove Structures & Slabs                               |   |           |                 |
| 350-2    | 1                    | LS   | Demolish & Remove Box Culvert (Phased Removal), & Ditch Lining     |   |           |                 |
| 350-3    | 1,076                | LF   | Remove Concrete Curb & Gutter                                      |   |           |                 |
| 350-4    | 525                  | LF   | Remove Concrete Sidewalk   |   |           |                 |
| 350-5    | 1                    | EA   | Remove Storm Drain Manhole   |   |           |                 |
| 350-6    | 3                    | EA   | Remove Sanitary Sewer Manhole                                      |   |           |                 |
| 350-7    | 1,032                | SY   | Remove Asphalt Pavement  |   |           |                 |
| 350-8    | 1                    | LS   | Remove and Replace Existing Bridge Sidewalks, Dados, Curbs & Rails |   |           |                 |
| 350-9    | 1                    | EA   | Remove, Store & Reinstall Catch Basin                              |   |           |                 |
| 350-10   | 1                    | EA   | Remove, Store & Reinstall Consumer's Light Pole                    |   |           |                 |
| 350-11   | 120                  | LF   | Remove 42" RGRCP   |   |           |                 |
| 350-12   | 80                   | LF   | Remove 20" Waterline   |   |           |                 |

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

PAGE 10-3

| Item No. | Approximate Quantity | Unit | Description  | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|--|---|-----------|-----------------|
| 350-13   | 1                    | LS   | Remove Three Fuel Storage Tanks & One Waste Storage Tank     |   |           |                 |
| 350-14   | 1                    | LS   | Miscellaneous Removals                                       |   |           |                 |
| 401-1    | 1                    | LS   | Traffic Control (Excluding Temporary Concrete Barriers)      |   |           |                 |
| 401-2    | 1,650                | LF   | Temporary Concrete Barrier                                   |   |           |                 |
| 401-3    | 1                    | EA   | Permanent Barricade (27' Long) (Detail P-1106, Type B)       |   |           |                 |
| 401-4    | 770                  | MH   | Uniformed, Off-Duty Law Enforcement Officer                  | Twenty and no/100                       | 20.00     | 15,400          |
| 420-1    | 1                    | EA   | Chain Link Gate (20' x 7')                                   |   |           |                 |
| 501-1    | 1                    | LS   | Sheet Piling & Related Professional Geotechnical Engineering |   |           |                 |
| 502-1    | 1,238                | LF   | Drilled Shaft Foundation (30" Diameter)                      |   |           |                 |
| 502-2    | 590                  | LF   | Drilled Shaft Foundation (42" Diameter)                      |   |           |                 |
| 505-1    | 695                  | CY   | Structural Concrete (Class A, f'c = 3,000 psi)               |   |           |                 |

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

Page BS-4

| Item No. | Approximate Quantity | Unit | Description  | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|--|---|-----------|-----------------|
| 505-2    | 64,925               | LB   | Steel Reinforcement  |   |           |                 |
| 505-3    | 847                  | LF   | Pipe (4" PVC, Schedule 40, for Ducts Encased in Bridge Sidewalk) |   |           |                 |
| 506-1    | 20                   | EA   | Precast, Prestressed Concrete Bridge Members (Box Girders)       |   |           |                 |
| 507-1    | 1                    | LS   | Canal Lining (to be Constructed During Dry-Up)                   |   |           |                 |
| 510-1    | 1,260                | SF   | Concrete Block Masonry   |   |           |                 |
| 515-1    | 2,457                | LB   | Miscellaneous Metal  |   |           |                 |
| 515-2    | 1                    | LS   | Temporary Pedestrian Bridge                                      |   |           |                 |
| 515-3    | 1                    | LS   | Special Aluminum Hatches for Lift Station                        |   |           |                 |
| 515-4    | 1                    | EA   | Jib Crane (7' High x 12' Radius)                                 |   |           |                 |
| 520-1    | 191                  | LF   | Ornamental Iron Fence  |   |           |                 |
| 525-1    | 151                  | SY   | Shotcrete (f'c = 3,000 psi)<br>(w/6 x 6 - W1.4 x W1.4 WWF)       |   |           |                 |
| 610-1    | 899                  | LF   | 12" DIP Waterline with Fittings                                  |   |           |                 |

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

Page BS-5

| Item No. | Approximate Quantity | Unit | Description                               | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|---|---|-----------|-----------------|
| 610-2    | 146                  | LF   | 8" DIP Waterline with Fittings            |   |           |                 |
| 610-3    | 16                   | LF   | 6" DIP Waterline with Fittings            |   |           |                 |
| 610-4    | 21                   | LF   | 4" DIP Waterline with Fittings            |   |           |                 |
| 610-5    | 132                  | LF   | 1 1/2" Copper Waterline                   |   |           |                 |
| 615-1    | 1,090                | LF   | 10" VCP Sanitary Sewer Line               |   |           |                 |
| 615-2    | 330                  | LF   | 12" VCP Sanitary Sewer Line               |   |           |                 |
| 615-3    | 16                   | LF   | 18" VCP Sanitary Sewer Line               |   |           |                 |
| 615-4    | 364                  | LF   | 10" DIP Force Main with Restrained Joints |   |           |                 |
| 618-1    | 280                  | LF   | 12" RCP Storm Drain                       |   |           |                 |
| 618-2    | 178                  | LF   | 42" RGRCP with Concrete Collars           |   |           |                 |
| 621-1    | 108                  | LF   | 72" x 44" CMPA                            |   |           |                 |
| 625-1    | 5                    | EA   | 48" Sanitary Sewer Manhole                |   |           |                 |
| 625-2    | 2                    | EA   | 60" Sanitary Sewer Manhole                |   |           |                 |
| 625-3    | 1                    | EA   | 60" Storm Sewer Manhole (MAG 420 and 520) |   |           |                 |
| 625-4    | 1                    | EA   | 8" Sanitary Sewer Cleanout                |   |           |                 |

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

Page BS-6

| Item No. | Approximate Quantity | Unit | Description  | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|--|---|-----------|-----------------|
| 630-1    | 2                    | EA   | 12" Tapping Sleeve, Valve, Box and Cover, Cap                        |   |           |                 |
| 630-2    | 2                    | EA   | 4" Tapping Sleeve, Valve, Box and Cover, Cap                         |   |           |                 |
| 630-3    | 2                    | EA   | 6" Gate Valve  |   |           |                 |
| 630-4    | 1                    | EA   | 6" x 1 1/2" Brass Tapping Saddle                                     |   |           |                 |
| 630-5    | 2                    | EA   | 20" Waterline Cap  |   |           |                 |
| 1200-1   | 2                    | EA   | Pumps, 20 Horsepower, 480-Volt AC, 3 Phase                           |   |           |                 |
| 1407-1   | 1                    | LS   | Odor Control   |   |           |                 |
| 1500-1   | 1                    | LS   | Piping, Valves, Gates and Specialties (within Lift Station Compound) |   |           |                 |
| 1600-1   | 1                    | LS   | Standby Generator (75 KW, Natural Gas)                               |   |           |                 |
| 1600-2   | 1                    | LS   | Control Panel  |   |           |                 |
| 1600-3   | 1                    | LS   | Switchboard  |   |           |                 |
| 1600-4   | 1                    | LS   | Underpass Lighting   |   |           |                 |

BIDDING SCHEDULE

Project: Seventh Street Bridge & Utility Relocations at the Arizona Canal Diversion Channel

Contract: FCD 88-24

Page BS-7

| Item No. | Approximate Quantity | Unit | Description  | Unit Cost (in writing) and /100 Dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|--|---|-----------|-----------------|
| 1600-5   | 1                    | LS   | Underground Conduit & Wire   |   |           |                 |
| 1600-6   | 1                    | LS   | Incidental Wiring, Fittings & Devices                              |   |           |                 |
| 1600-7   | 1                    | LS   | Service Conduit, Wiring and Pad for APS and Bell Telephone Conduit |   |           |                 |
| 1700-1   | 1                    | LS   | Circular Chart Recorder  |   |           |                 |
| 1700-2   | 1                    | LS   | 8" Magnetic Flowmeter  |   |           |                 |

BID SCHEDULE

Project: Water & Sewer Line Relocation from Central Ave. to 7th Ave.

Contract: FCD 88-24

Page BS-8

| Item No. | Approximate Quantity | Unit | Description   | Unit Cost (in writing) and /100 dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|---|---|-----------|-----------------|
| 336-1    | 120                  | SY   | A.C. Pavement Replacement MAG Std. DTL 200 Type "A"               |   |           |                 |
| 336-2    | 41.4                 | SY   | A.C. Pavement Replacement MAG Std. DTL 200 Type "B"               |   |           |                 |
| 340-6    | 16                   | LF   | Sawcut, Remove & Replace Roll Curb & Gutter MAG Std. DTL 220      |   |           |                 |
| 340-7    | 10                   | LF   | Sawcut, Remove & Replace Vertical Curb & Gutter MAG Std. DTL 220  |   |           |                 |
| 340-8    | 50                   | SF   | Sawcut, Remove & Replace Concrete & Sidewalk G.O.P. Std. DTL 1230 |   |           |                 |
| 340-9    | 144                  | SF   | Sawcut, Remove & Replace Driveway C.O.P. Std. DTL 1255            |   |           |                 |

BID SCHEDULE

Project: Water & Sewer Line Relocation from Central Ave. to 7th Ave.

Contract: FCD 88-24

Page BS-9

| Item No. | Approximate Quantity | Unit | Description                                     | Unit Cost (in writing) and /100 dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|---|---|-----------|-----------------|
| 350-15   |                      | LS   | Miscellaneous Removal & Other Work              |   |           |                 |
| 350-16   |                      | LS   | Remove existing trees                           |   |           |                 |
| 401-5    |                      | LS   | Traffic Control                                 |   |           |                 |
| 610-6    | 570                  | LF   | 6" Water Line                                   |   |           |                 |
| 610-7    | 18                   | LF   | 4" Water Line                                   |   |           |                 |
| 610-8    | 32                   | LF   | 6" M.J.D.I.P.                                   |   |           |                 |
| 610-9    | 9                    | LF   | 4" M.J.D.I.P.                                   |   |           |                 |
| 610-10   | 4                    | EA   | 6" Tapping Sleeve & Gate Valve MAG Std. DTL 340 |   |           |                 |

BID SCHEDULE

Project: Water & Sewer Line Relocation from Central Ave. to 7th Ave.

Contract: FCD 88-24

Page BS-10

| Item No. | Approximate Quantity | Unit | Description  | Unit Cost (in writing) and /100 dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|--|---|-----------|-----------------|
| 610-11   | 2                    | EA   | 4" Tapping Sleeve & Gate Valve MAG Std. DTL 340      |   |           |                 |
| 610-12   | 1                    | EA   | 6" x 4" Tapping Sleeve & Gate Valve MAG Std. DTL 340 |   |           |                 |
| 610-13   | 6                    | EA   | Valve Box & Cover MAG Std. DTL 391-1 Type "A"        |   |           |                 |
| 610-14   | 2                    | EA   | Valve Box & Cover MAG Std. DTL 391-1 Type "B"        |   |           |                 |
| 610-15   | 3                    | EA   | 6" 45 degree Bend                                    |   |           |                 |
| 610-16   | 3                    | EA   | 4" 90 degree Bend                                    |   |           |                 |

BID SCHEDULE

Project: Water & Sewer Line Relocation from Central Ave. to 7th Ave.

Contract: FCD 88-24

Page BS-11

| Item No. | Approximate Quantity | Unit | Description                        | Unit Cost (in writing) and /100 dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|------------------------------------|---|-----------|-----------------|
| 610-17   | 1                    | EA   | 6" Tee                             |   |           |                 |
| 610-18   | 1                    | EA   | 6" x 4" Tee                        |   |           |                 |
| 610-19   | 1                    | EA   | Fire Hydrant MAG<br>Std. DTL 360   |   |           |                 |
| 610-20   | 500                  | LB   | Misc. Iron Fittings                |   |           |                 |
| 610-21   | 3                    | EA   | 6" Dresser Coupling                |   |           |                 |
| 610-22   | 2                    | EA   | 4" Dresser Coupling                |   |           |                 |
| 610-23   | 2                    | EA   | Cut & Plug Exist.<br>6" Water Line |   |           |                 |

BID SCHEDULE

Project: Water & Sewer Line Relocation from Central Ave. to 7th Ave.

Contract: FCD 88-24

Page BS-12

| Item No. | Approximate Quantity | Unit | Description   | Unit Cost (in writing) and /100 dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|---|---|-----------|-----------------|
| 610-24   | 4                    | EA   | Cut & Plug<br>Exist. 4" Water<br>Line                         |   |           |                 |
| 610-25   | 9                    | LF   | Water Line Encasement   |   |           |                 |
| 615-5    | 2695                 | LF   | 10" VCP   |   |           |                 |
| 615-6    | 169                  | LF   | 8" VCP  |   |           |                 |
| 615-7    | 3                    | EA   | Cut & Plug Ex. 8"<br>& 10" Sanitary<br>Sewer MAG Std. DTL 427 |   |           |                 |
| 615-8    | 38                   | LF   | Sewer Encasement  |   |           |                 |
| 615-9    | 2                    | EA   | Phase II Cut & Plug<br>Exist. 10" Sanitary<br>Sewer           |   |           |                 |

BID SCHEDULE

Project: Water & Sewer Line Relocation from Central Ave. to 7th Ave.

Contract: FCD 88-24

Page BS-13

| Item No. | Approximate Quantity | Unit | Description   | Unit Cost (in writing) and /100 dollars | Unit Cost | Extended Amount |
|----------|----------------------|------|---|---|-----------|-----------------|
| 625-4    | 11                   | EA   | New Sanitary Sewer Man-hole MAG Std. DTL 420 & 424            |   |           |                 |
| 625-5    | 1                    | EA   | New Sanitary Sewer Man-hole MAG Std. DTL 420 424 & 426 (mod.) |   |           |                 |
| 625-6    | 1                    | EA   | New Sanitary Sewer Man-hole MAG Std. DTL 421 & 424            |   |           |                 |

PROJECT TOTAL \_\_\_\_\_

THE BIDDER HEREBY ACKNOWLEDGES RECEIPT OF AND AGREES HIS PROPOSAL IS BASED ON THE FOLLOWING ADDENDA.

---

The Undersigned further proposes to execute the Contract Agreement and furnish satisfactory Bonds within ten (10) days from the date of award, time being of the essence. The undersigned further proposes to begin the work as specified in the Contract attached hereto, and to complete the work within the time limits as specified in the Special Provisions and maintain at all times a Contract Bond, approved by the Board of Directors, in an amount equal to one hundred percent (100%) of the total bid. This bond shall serve not only to guarantee the completion of the work on the part of the Undersigned, but also to guarantee the excellence of both workmanship and material and the payment of all obligations incurred, said Bond to be in full force and effect until the work is finally accepted and the provisions of the Plans, Specifications and Special Provisions are fulfilled.

A Proposal guaranty in the amount and character named in the Invitation for Bids is enclosed amounting to not less than five percent (5%) of the total bid, which Proposal guaranty is submitted as a guaranty of the good faith of the Bidder and that the Bidder will enter into written contract, as provided, to do the work, if successful in securing the award thereof; and it is hereby agreed that if at any time other than as provided in the Proposal requirements and conditions the Undersigned should withdraw this Proposal, or if the Proposal is accepted and there should be failure on the part of the Undersigned to execute the Contract and furnish satisfactory Bond as herein provided, the Flood Control District of Maricopa County in either of such events, shall be entitled and is hereby given the right to retain the said Proposal guaranty as liquidated damages.

Date: \_\_\_\_\_, 19\_\_.

IF BY AN INDIVIDUAL: License No. \_\_\_\_\_ Classification \_\_\_\_\_

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Address)

IF BY A FIRM OR PARTNERSHIP: License No. \_\_\_\_\_ Classification \_\_\_\_\_

\_\_\_\_\_  
(Firm Name)

\_\_\_\_\_  
(Firm Address)

By: \_\_\_\_\_

\*Name and Address of Each Member:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PROPOSAL  
CONTRACT NO. FCD 88-24

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Date \_\_\_\_\_, 19\_\_.

IF BY A CORPORATION: License No. \_\_\_\_\_ Classification \_\_\_\_\_

\_\_\_\_\_  
(Corporate Name) (Corporation Address)

By: \_\_\_\_\_

\*\*Incorporated under the Laws of \_\_\_\_\_

Names and Addresses of Officers:

\_\_\_\_\_  
(President) (Address)

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

\_\_\_\_\_  
(Treasurer) (Address)

\*The name and post office address of each member of the firm or partnership must be shown.

\*\*The name of the State under which the Corporation was chartered and names, title, and business address of the President, Secretary, and Treasurer must be shown.

PROPOSAL  
CONTRACT NO. FCD 88-24

SURETY BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, \_\_\_\_\_, as Principal, (hereinafter called the Principal), and the \_\_\_\_\_, a corporation duly organized under the laws of the State of \_\_\_\_\_, as Surety, (hereinafter called the Surety), are held and firmly bound unto the Flood Control District of Maricopa County as Obligee, in the sum of \_\_\_ percent (\_\_\_%) of the total amount of the bid of Principal, submitted by him to the Flood Control District of Maricopa County, for the work described below, for the payment of which sum, well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, and administrators, successors and assigns, jointly and severally, firmly by these presents, and in conformance with A.R.S.

WHEREAS, the said Principal is herewith submitting its proposal for \_\_\_\_\_

NOW, THEREFORE, if the Flood Control District of Maricopa County shall accept the proposal of the Principal and the Principal shall enter into a contract with the Flood Control District of Maricopa County in accordance with the terms of such proposal and give such Bonds and Certificates of Insurance as specified in the Standard Specifications with good and sufficient Surety for the faithful performance of such contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter into such contract and give such Bond and Certificates of Insurance, if the Principal shall pay to the Flood Control District of Maricopa County the sum of money set forth above as liquidated damages for failure of the Principal to enter into the contract, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this \_\_\_\_\_ day of \_\_\_\_\_, A.D., 19\_\_.

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Title

Witness:

\_\_\_\_\_

\_\_\_\_\_  
Surety

\_\_\_\_\_  
Title

Witness:

\_\_\_\_\_





CONSTRUCTION SPECIAL PROVISIONS  
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
SEVENTH STREET BRIDGE AND UTILITY RELOCATIONS  
AT THE  
ARIZONA CANAL DIVERSION CHANNEL

Pages 1 through 9 of these Construction Special Provisions apply to the plans prepared by John Carollo Engineers for the Seventh Street Bridge over the Arizona Canal Diversion Channel (Sheets 1 through 28 of 28) AND the plans prepared by Morrison-Knudsen Engineers for the Sewer Relocation-Central to 7th Street (sheets 1 through 8 of 8) AND the Morrison-Knudsen plans for the Water Relocation-Central Avenue, 1st St. and Butler (sheets 1 through 4 of 4).

Pages 10 through 114 of these Construction Special Provisions apply to the plans prepared by John Carollo Engineers for the Seventh Street Bridge over the Arizona Canal Diversion Channel (sheets 1 through 28 of 28).

Pages 115 through 119 of these Construction Special Provisions apply to the plans prepared by Morrison-Knudsen Engineers for the Sewer Relocation-Central to 7th Street (sheets 1 through 8 of 8) AND the Morrison Knudsen plans for the Water Relocation-Central Avenue, 1st St. and Butler (sheets 1 through 4 of 4).

LOCATION OF THE WORK

The proposed work is located in the vicinity of 7th Street and Griswold Road, north of the Arizona Canal, and along Las Palmaritas Drive from Central Avenue to 7th Street, Phoenix, Arizona.

PROPOSED WORK

The work consists of constructing a prestressed girder bridge, temporary detours, approach roadways, a sanitary sewer lift station, underground utilities modifications, and other miscellaneous items of work required for the completion of the project.

STANDARD SPECIFICATIONS

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

#### PRECEDENCE OF CONTRACT DOCUMENTS

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

#### PAYMENT

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

#### NEGOTIATION CLAUSE

Recovery of damages related to expenses incurred by the Contractor for a delay for which the Flood Control District of Maricopa County is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the Contract, shall be negotiated between the Contractor and the Flood Control District of Maricopa County. This provision shall not be construed to void any provision in the Contract which requires notice of delays, provides for arbitration or other procedure for settlement or provides for liquidated damages.

#### WORK STANDARDS

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

#### CONTRACT TIME

The Contractor shall start work within seven (7) calendar days after Notice to Proceed. Contract duration shall be 210 calendar days.

Work which must be accomplished during the Arizona Canal dry-up shall be scheduled to occur between November 18, 1988 and December 17, 1988.

It is not anticipated that a contract for construction of the Arizona Canal Diversion Channel will be awarded before the completion of this Contract.

#### WATER, LIGHT, POWER, HEAT, TELEPHONE

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

## PROGRESS SCHEDULE

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

## MATERIAL SOURCES

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

### 101.2 DEFINITIONS AND TERMS

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

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

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

### 102 ADDENDA AND SUBMISSION OF BIDDING SCHEDULE

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

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

### 102.5 PREPARATION OF PROPOSAL

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

103.6 CONTRACTOR'S INSURANCE

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

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

104.1.2 TRAFFIC REGULATIONS

A. The following shall be considered major streets.

7th Street  
Central Avenue

- B. All traffic and/or traffic control devices on this project shall be provided, maintained and/or controlled as specified in the City of Phoenix Traffic Barricade Manual, latest revision.
- C. Permission to restrict City streets, sidewalks, and alleys (street closure permits) shall be requested as specified in Section III of the Traffic Barricade Manual.
- D. Unless otherwise provided for in the Plans all traffic on this project shall be regulated as specified in Section IV of the Traffic Barricade Manual.
- E. Seventh Street at the Arizona Canal. Seventh Street can be reduced to four lanes (two each way) when construction requires. During detour tie-ins, Seventh Street can be reduced to two lanes (one each way) weekends, 24 hours.

The Contractor shall notify the City of Phoenix Streets and Traffic Department 30 days prior to the start of construction to remove overhead signs and suspend the reversible lane.

The Contractor shall notify the City of Phoenix Streets and Traffic Department 48 hours prior to street closures.

During storm drain and utility relocation, Seventh Street can be reduced to four lanes (two each way) weekdays 9:00 A.M. to 4:00 P.M., two lanes (one each way) weeknights 7:00 P.M. to 6:00 A.M. and 24 hours on weekends. During other times, all lanes shall be open.

F. Central Avenue. The Contractor shall maintain Central Avenue open to traffic (one lane in each direction) at all times.

104.20      SUBSURFACE INVESTIGATION

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

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

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

105.2      PLANS AND SHOP DRAWINGS

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

1. Detailed sequence of construction
2. Concrete mix designs
3. Precast girders
4. Reinforcing steel
5. Metal fencing
6. Bearing pads
7. Shoring and bracing plans for structure excavation
8. Falsework plans and design calculations
9. Fabricated pipe and design data, including rubber gaskets
10. Precast manhole risers
11. Castings
12. Utility protection plans
13. Epoxy lined 10-inch force main

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

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

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

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

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

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

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

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

#### 105.5 JOB OFFICE

The Contractor shall provide a job office at the work site to facilitate construction management of the project. Sixty-four (64) square feet of office space, equipped with suitable desk, telephone, chair, plan rack, photostatic copier, and filing cabinet shall be provided in the Contractor's job office for the use of the Owner's Field Representative throughout the construction of the project.

#### 105.6 COOPERATION WITH UTILITIES

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

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

|   |            |
|---|------------|
| Flood Control District.....                             | 262-1501   |
| Mountain Bell Telephone Company - Fred Locke.....       | 842-7720   |
| Salt River Project - Tim Phillips.....                  | 236-2956   |
| Arizona Public Service - Lois Winkler.....              | 371-6837   |
| Location Staking (APS, Mountain Bell, SRP).....         | 263-1100   |
| City of Phoenix Streets and Traffic - Marshal Hollen... | 262-6565   |
| City of Phoenix Water and Wastewater - Gerald Arakaki.. | 261-8229   |
| Southwest Gas Company - Sam McConnell.....              | 866-4074   |
| Dimension Cable Services - Blare Tanner.....            | 866-0072   |
|   | (Ext. 243) |

105.8 CONSTRUCTION STAKES, LINES AND GRADES

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

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

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

The Flood Control District of Maricopa County reserves the right to adjust design grades or the locations of the sewer line structures prior to construction if, in the opinion of the Engineer, it should become necessary, without additional cost to the Flood Control District of Maricopa County.

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

105.10 INSPECTION OF WORK

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

106      CONTROL OF MATERIALS

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

106.3      PLANT INSPECTION

The Contractor shall be responsible for all expenses, including but not limited to, travel and per diem expenses, for required inspections by the Engineer and/or the cost of inspection and testing by an independent testing laboratory as required by and at the discretion of the Engineer for any inspection of precast concrete girders manufactured outside of a fifty-mile radius from the City limits of Phoenix, Arizona.

106.5      CONTRACTOR'S MARSHALING YARDS

The Contractor shall obtain approval of the Engineer when using vacant property to park and service equipment and store material for use.

- A. The Contractor shall notify adjacent property owners/residents of this proposed use.
- B. Any use of vacant property adjacent to or near the project for parking or servicing equipment and/or storing material will require the Contractor to obtain written approval from the property owner. This approval shall contain any requirements which are a condition of this approval.
- C. A copy of the property owner's approval shall be submitted, along with the Contractor's request to the Engineer for approval for the use of the marshaling yard in connection with the project. An appropriate distance from adjacent property will be set by the Engineer on a case by case basis based on the size and type of equipment to be used on the project.

107.2      PERMITS

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

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

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

108.5 LIMITATION OF OPERATIONS

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

108.9 FAILURE TO COMPLETE ON TIME

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

109 MEASUREMENTS AND PAYMENTS

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

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

## SEVENTH STREET BRIDGE AND UTILITY RELOCATIONS

Pages 1 through 9 of these Construction Special Provisions apply to the plans prepared by John Carollo Engineers for the Seventh Street Bridge over the Arizona Canal Diversion Channel (Sheets 1 through 28 of 28) AND the plans prepared by Morrison-Knudsen Engineers for the Sewer Relocation-Central to 7th Street (sheets 1 through 8 of 8) AND the Morrison-Knudsen plans for the Water Relocation-Central AVenue, 1st St. and Butler (sheets 1 through 4 of 4).

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### 201 CLEARING AND GRUBBING

The work under this item consists of removal and disposal of all trees, stumps, asphaltic pavement, and structures within the limits of the roadways, canal and other areas designated on the Plans. Materials shall be disposed of off-site. Also see Sections 205.6 and 350 in these Special Provisions.

### 205.6 DISPOSAL OF SURPLUS MATERIAL

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

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

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

206      STRUCTURE EXCAVATION AND BACKFILL

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

The Contractor shall provide sheet piling or other means of support for excavation to protect detour road, underground utilities and private property during construction. Prior to excavating for the construction of the piers and abutments, the Contractor shall submit a complete detailed shoring and bracing plan prepared by and bearing the seal and signature of a licensed Professional Civil or Structural Engineer of the State of Arizona.

Structure backfill behind the abutments and wing walls shall be compacted in accordance with Table 601-2, Type III of the Uniform Standard Specifications, unless noted otherwise on the Plans.

301      SUBGRADE PREPARATION

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

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

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

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

310      UNTREATED BASE

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

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

315

BITUMINOUS PRIME COAT

Item 315-1 shall conform in its entirety to requirements of Section 315. The bituminous material shall be Grade MC-70 or MC-250 liquid asphalt as determined by the Engineer. Prime coat shall be applied to the total width of the aggregate base material at the rate of 0.40 gallon per square yard unless otherwise specified by the Engineer.

321

ASPHALT CONCRETE PAVEMENT

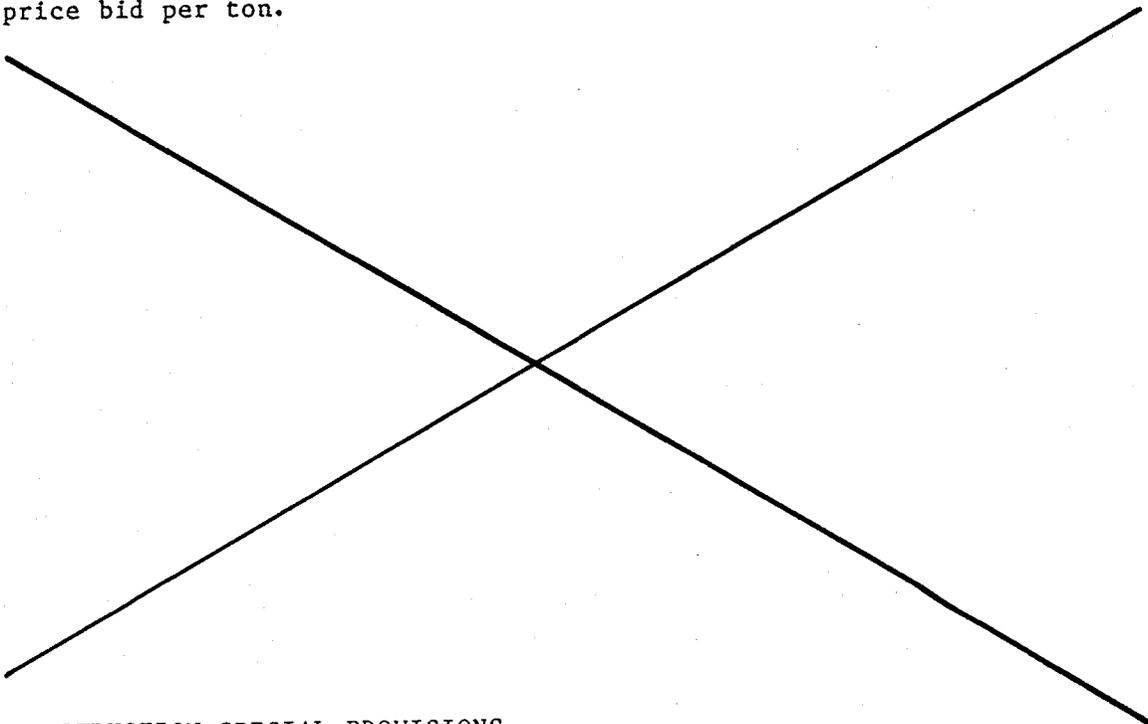
Asphalt concrete pavement shall consist of furnishing and placing a plant-mixed asphalt concrete road surfacing material to the compacted thickness shown on the Plans and in accordance with Section 321 of the Uniform Standard Specifications.

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

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

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

Payment for Items 321-1 and 321-2 will be made at the Contract unit price bid per ton.



324 PORTLAND CEMENT CONCRETE STREET PAVEMENT

PCC street pavement shall consist of furnishing and placing portland cement concrete pavement to the thickness and details shown on the Plans and in accordance with Section 324 of the City of Phoenix Supplement of the Uniform Standard Specifications.

Payment for this item will be made at the unit price bid per square yard for Item 324-1 - Portland Cement Concrete Pavement.

Payment for bridge approach slabs will be in accordance with the appropriate item listed in Section 505 - Concrete Bridge Structures.

340 CONCRETE CURB AND GUTTER, SIDEWALKS, DRIVEWAYS AND ALLEY ENTRANCES

Items 340-1 through 340-5 of this project shall conform in its entirety to Section 340 of the MAG Standard Specifications.

350 REMOVAL OF EXISTING IMPROVEMENTS

Removal and replacement of sidewalks, dados, curbs and bridge rails from the existing Arizona Canal Bridge: removals shall be to the extent necessary to provide for detours, temporary pedestrian bridge and temporary barrier placement as indicated on the Plans.

Removed sections of bridge rail shall be stored for later installation. Curb, sidewalks and dados shall be rebuilt in kind after the removal of the applicable detour. Steel reinforcement which is cut off flush with bridge deck shall be extended by butt welding new reinforcing to existing in accordance with "Structural Welding Code - Reinforcing Steel" (AWS D1.4-79). Chipping of concrete deck around existing bars will be necessary to accomplish welds.

Removal of fuel storage and waste storage tanks shall be in accordance with Supplement "A" of these Special Provisions and with all Federal, State and local requirements. The Contractor shall obtain all permits required.

401 TRAFFIC CONTROL

Attention is directed to Section 401.2, Traffic Control Devices, of the MAG Standard Specifications, and to the City of Phoenix Traffic Barricade Manual.

Part A of Section 401.2 shall include traffic striping, including but not limited to, pedestrian crosswalks, cross-hatch and lane lines, raised pavement markers and pavement striping removal, as indicated on the Plans.

The lump sum unit price for Item 401-1, Traffic Control, shall include all items, except temporary concrete barriers, relating to traffic

control for maintaining necessary and adequate devices for the protection of the work, the workmen and the traveling public.

Payment for temporary concrete barriers will be at the unit price bid for Item 401-2, Temporary Concrete Barriers.

Payment for permanent barricade will be at the unit price bid for Item 401-3, Permanent Barricade.

POLICE OFFICER REQUIREMENTS: The Contractor shall provide one off-duty police officer at the Seventh Street and Butler signalized intersection whenever excessive traffic delays or congestion occur at this intersection, as determined and directed by the City of Phoenix Traffic Engineer. Police officer hours may be reduced to peak traffic hours at the direction of the Traffic Engineer.

During the operation of either the Phase I or Phase II detour, the Contractor shall provide one off-duty police officer at the intersection of Seventh Street and Las Palmaritas to direct traffic into and out of the offices of Valley Wide Realty at the southeast corner of this intersection. Access into and out of the Valley Wide Realty offices will be from the north side driveway on Las Palmaritas. This will be required every Wednesday evening from 6:30 P.M. to 10:30 P.M. while the detours are in operation.

Payment for off-duty police officer will be made at the current contractor's hourly rate which is approximately \$20.00 per hour. Bid Item 401-4, Uniformed, Off-Duty Law Enforcement Officer, shall be based on 770 man-hours for an item bid cost of \$15,400.00, and will be paid on an as-used basis.

#### 405.5.1 SURVEY MONUMENTS

Survey monuments outside the surface replacement limits (defined in Section 336 of MAG) which are disturbed by the Contractor shall be restored or replaced by the Contractor at no additional cost to the Owner, except for those survey monuments whose replacement is indicated on the Plans.

#### 420 CHAIN LINK GATES

Chain link gates shall be installed as indicated on the Plans and herein specified.

Fencing may be constructed at any time after the earthwork, pipe work, and structures to which the fence is related have been completed.

The gate shall be protected against damage and, if damaged, it shall be repaired prior to final acceptance.

Except where indicated differently on the Plans, gate posts and concrete foundations for gate posts shall be as determined by the following schedule:

| <u>Gate Leaf Width,</u><br><u>feet</u> | <u>Size OD,</u><br><u>inches</u> | <u>Weight,</u><br><u>lb/lf</u> | <u>Concrete Foundation</u>        |                              |
|--|----------------------------------|--------------------------------|-----------------------------------|------------------------------|
|  |                                  |                                | <u>Diameter,</u><br><u>inches</u> | <u>Depth,</u><br><u>feet</u> |
| 0 to 6                                 | 2-7/8                            | 5.79                           | 12                                | 4                            |
| Over 6 to 13                           | 4                                | 9.11                           | 18                                | 3                            |
| Over 13 to 18                          | 6-5/8                            | 18.97                          | 18                                | 4                            |
| Over 18                                | 8-5/8                            | 24.70                          | 18                                | 4.5                          |

Gate posts shall have vertical extension arms with three strands of barbed wire.

All posts, rails, and appurtenances shall be hot dipped zinc coated steel per ASTM A 120, A 121, A 123, or A 153, whichever is applicable. Pipe posts shall have tops which exclude moisture. End corner, pull, and gate posts shall be braced with the same material as top rail and trussed to line posts with 3/8 inch rods and tighteners.

The fabric shall be connected to the line posts with 6-gauge hot dip galvanized wire clips every 14 inches, to terminal, corner, and gate posts by using 1/4 inch by 3/4 inch tension bars tied to posts every 14 inches with 11-gauge, 1-inch wide, hot dip galvanized steel bands and 3/8 inch diameter bolts and nuts, and to tension wires with 11-gauge hog rings every 24 inches.

Post top fittings shall have galvanized, 45-degree angle extension arms. Three barbed wire strands shall be carried on each extension arm. The top rail shall pass through the extension arm fitting.

#### 420.1 SWING GATES

Except as otherwise indicated or specified, all chain link fence gates shall be swing gates.

Swing chain link gates shall be provided where indicated on the Plans. Gate frames shall be made of 1.90-inch OD galvanized pipe weighing 2.72 pounds per linear foot. Corner fittings shall be heavy pressed steel or malleable castings.

Gates shall be provided with 3/8 inch galvanized cross tensioning rods and turnbuckles rigidly attached to the gate frame.

The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Vertical stiffeners shall be provided on gates at 6 feet on center on gates 12 feet and wider and horizontal stiffeners shall be provided for gates over 7 feet in height.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified for fence construction, and suitable tension connectors spaced at approximately 16-inch intervals.

Gate shall be provided with a combination steel or malleable iron catch and locking attachment of acceptable design. Stops to hold gates open and a center rest with catch shall be provided where required.

Payment for chain link gate will be made at the unit price bid for Item 420-1, Chain Link Gate.

501        SHEET PILING

Contractor shall retain the services of a professional geotechnical engineer licensed to practice civil or structural engineering in the State of Arizona. The Contractor's engineer shall design, prepare plans, and monitor installation of temporary sheet piling or equivalent material to retain excavations adjacent to detour roadways as indicated on the Plans. No installation of sheet piling or equivalent material may proceed until plans have been accepted by the Engineer.

Payment for sheet piling and related geotechnical engineering will be made at the lump sum price bid for Item 501-1, Sheet Piling.

502        DRILLED SHAFT FOUNDATIONS

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

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

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

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

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

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

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

#### MATERIALS:

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

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

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

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

#### CONSTRUCTION REQUIREMENTS:

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

Project Plan location. When bells or rock sockets are required, they shall be excavated so as to form a bearing area of the size and shape indicated on the Project Plans.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

#### CONCRETE:

General: Concrete shall be placed as soon as possible after completion of the shaft and the placement of the reinforcing steel cage. Any sloughage or other loose material shall be machine cleaned from the shaft prior to placing reinforcing steel and concrete. An

accumulation of loose soils, muck, etc., at the bottom of the shaft will not be allowed at the time of placing steel or concrete. A flight auger shall not be used for cleaning purposes.

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

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

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

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

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

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

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

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

TEST DRILLED SHAFT: Unless otherwise directed by the Engineer, a test drilled shaft is not required. The Contractor shall construct one full-depth drilled shaft of the size and to the tip

elevation specified on the Project Plans in accordance with the submission hereinbefore described under "General Requirements" in order that the proposed equipment, materials and procedures may be tested and to allow the Engineer to determine the extent and kinds of inspection, all as necessary to maintain the structural integrity of the bridge foundation.

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

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

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

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

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

Gamma ray testing will not be required unless it is necessary for the Contractor to use a drilling slurry.

If required, each completed drilled shaft will be inspected by means of a gamma ray logging device. The Contractor shall furnish and install two-inch inside diameter polyvinyl chloride pipe (Schedule 40). The pipe shall be joined with glued couplers to provide a clean, dry and unobstructed two-inch diameter clear opening from the top of the shaft to the tip. The pipe shall be capped top and bottom and shall be securely tied to the reinforcing steel in a straight line in order to

prevent displacement during handling and concrete placement and permit the gamma ray logging device to pass top to bottom. The Engineer will provide the testing equipment and make the actual inspection.

If the inspection indicates the presence of voids or zones of unconsolidated concrete in the drilled shaft, the concrete shall be core drilled or otherwise exposed as directed by the Engineer.

After all inspection has been completed, all holes and conduit in all bridge drilled shaft foundations shall be filled with an approved sand-cement grout.

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

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

BASIS OF PAYMENT: The accepted quantities of drilled shafts, including test drilled shafts, if required, measured as provided above, will be paid for at the Contract unit price per linear foot for Item 502-1, Drilled Shaft Foundation (30") and for Item 502-2, Drilled Shaft Foundation (42"). The price paid shall be for drilled shafts, complete in place, including excavation, drilling slurry, metal casing, steel reinforcing, portland cement concrete, concrete slabs, and any needed forming, curing and finishing. No additional payment will be made for belled sections or for metal casing that is to remain in place.

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

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

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

The Contract unit price shall also include the cost of furnishing and placing conduit and the subsequent filling with a sand-cement grout.

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

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

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

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

#### 505 CONCRETE BRIDGE STRUCTURES

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

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

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

No vehicular loads will be permitted on the bridges before the lapse of twenty-one (21) days from the date of the last pour of concrete for the pedestrian overpass deck, unless approval is obtained in writing from the Engineer. The Contractor shall take special precautions to keep the area around the bridges properly barricaded and marked with flares to prevent automotive traffic from crossing the new bridge structures prior to the Project Engineer's approval.

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

Portland cement concrete shall conform to Section 725 of the MAG Uniform Standard Specifications.

The following strengths of concrete shall be furnished for Cast-in-Place Elements:

Item 505-1 - Class "A" Concrete f'c = 3,000 psi  
Approach Slabs, Cap Beams, Abutment, Box Culvert, Lift Station

The Contractor shall determine the mix proportions and shall furnish concrete which conforms to the requirements of these Specifications. All concrete shall be sufficiently workable, at the slump proposed by the Contractor within the specified range, to allow proper placement of the concrete without harmful segregation, bleeding, or incomplete consolidation. It shall be the responsibility of the Contractor to proportion, mix, place, finish, and cure the concrete properly in accordance with the requirements of these Specifications.

ADMIXTURES: The Contractor shall furnish Certificates of Compliance conforming to the requirements of MAG Subsection 106.2 for each type of admixture furnished. Admixtures containing chlorides will not be acceptable for concrete containing uncoated reinforcing steel or embedded metal items.

All concrete admixtures shall be stored in suitable containers in accordance with the manufacturer's recommendations. All liquid admixtures shall be protected from freezing.

Air-entraining admixtures shall conform to the requirements of AASHTO M 154.

Water reducing admixtures shall conform to the requirements of AASHTO M 194.

Fly ash shall conform to the requirements of ASTM C 618 for Class F, except that the pozzolanic activity index with lime shall be reduced to a minimum of 650 pounds per square inch at seven days. The Blaine fineness shall have an average value of at least 2,800, with a minimum value of 2,600 for any one sample. The average value will be determined on the last five consecutive samples. The loss on ignition shall not exceed 3.0 percent.

DESIGN OF CONCRETE MIX: Portland cement concrete shall comply with Section 725 of the MAG Uniform Standard Specification for Public Works Construction.

A fly ash admixture may be used at the option of the Contractor only when portland cement is used. A maximum of 15 percent of the required weight of portland cement may be replaced with a fly ash admixture. A minimum of 1.2 pounds of fly ash shall replace each 1.0 pound of portland cement removed.

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

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

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

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

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

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

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

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

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

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

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

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

PEDESTRIAN UNDERPASS: The placing of concrete will not be permitted until the Engineer is satisfied that the rate of producing and placing concrete shall be sufficient to complete the proposed pour and finishing operations within the scheduled time, that experienced concrete finishers are available to finish the deck, and that all necessary finishing tools and equipment are on hand at the site of the work and are in satisfactory condition for use.

Concrete shall be placed for the full width of the panel to be poured. After the concrete has been placed, it shall be consolidated and then struck off by means of self-propelled or manual screed equipment.

FINISHING PEDESTRIAN UNDERPASS: Bridge sidewalks shall be finished to a light broomed texture.

The pedestrian underpass deck shall be textured with a burlap drag or drag broom in accordance with the requirements of Section 324.3.7 of the City of Phoenix 1987 Supplement to the MAG Uniform Standard Specifications.

Hand brooms shall be provided and available at the jobsite at all times when texturing plastic concrete.

The finishing operation shall be completed before the water sheen disappears. Water shall not be applied to the deck surface at any time during floating or finishing, except in the form of a fog spray.

Fogging equipment shall be capable of applying water to the concrete in the form of a fine fog mist in sufficient quantity to curb the effects of rapid evaporation of mixing water from the concrete on the deck resulting from wind, high temperature, low humidity, or a combination of these factors.

The finished surface of the concrete shall be tested by means of a 10-foot straightedge placed on the deck surface. The surface plane shall not vary more than  $1/8$  inch, as measured from the bottom of the straightedge, on deck surfaces exposed directly to traffic.

Areas showing deviations greater than those specified shall be corrected in a manner approved by the Engineer. All corrected areas shall be textured to match the finish of the surrounding deck surface.

All areas corrected shall not show deviations in excess of that specified when tested with a 10-foot straightedge.

Concrete curing shall be accomplished with both white pigmented curing compound and water curing in accordance with Sections 505 and 726 of the Standard Specifications.

TESTS ON FINISHED STRUCTURES:

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

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

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

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

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

Where indicated on the Plans, the bars shall be Grade 60.

Where Grade 60 is not specified on the Plans, Grade 40 shall be used if it is immediately available. If Grade 40 is not immediately available, Grade 60 may be used exclusively, or in combination with Grade 40, provided that the conditions under which the grades are used in combination are acceptable to the Engineer and further provided that there is no additional cost to the Owner.

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

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

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

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

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

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

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

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

PVC DUCTS: All conduit and fittings within bridge sidewalks shall be listed by UL, and conform to NEC standards. All conduit shall be rigid polyvinyl chloride (PVC) nonmetallic type conforming to the requirements of UL651 for rigid nonmetallic conduit, PVC conduit and fittings shall be Schedule 40, heavy wall, manufactured from high impact material and shall be rated for use at 90 degrees Centigrade.

Conduit in bridge sidewalk shall be installed in accordance with details indicated on the Plans. Each conduit shall be equipped with a pull-wire. PVC expansion sleeves shall be installed at the abutment walls. All conduits shall be cleaned and "blown out" with compressed air. Ends of conduit shall be fitted with a PVC cap. Tracer wires and markers shall be installed for future locating.



510            MASONRY

This Specification shall be used for all masonry work in lieu of MAG Section 510, Concrete Block Masonry.

510.1        GENERAL

All work shall be executed in a workmanlike manner and in full compliance with all applicable codes and ordinances.

All sills, ledges, offsets, and other projections shall be protected from droppings or mortar, and all construction by other trades shall be protected from effects of masonry work.

All concrete masonry walls shall be laid in uniform and true courses, level, plumb and without projection or offset of adjacent block. The foundation shall be thoroughly cleaned of all laitance, grease, oil, mud, dirt, mortar droppings, or other objectionable matter by means of a bush hammer or heavy sandblasting before placing the first course of masonry units. Full mortar bedding shall be used for the first course on the foundation. Full mortar coverage shall be provided on all face shells and webs. Vertical head joints shall be buttered well for a thickness equal to the face shell of the masonry unit, and these joints shall be shoved tightly so that the mortar bonds well to both masonry units. Joints shall be solidly filled from the face of the masonry units to the depth of the face shell.

Masonry units shall be laid in the wall to the desired height with joints of uniform thickness. Units shall be leveled, plumbed, and straightened before the mortar has stiffened. Bond shall be plumb throughout.

All masonry units shall be laid to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full-bedded in mortar to prevent leakage of grout or insulation. All head joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

Masonry units shall be laid in such a way that cracks are not formed at the time the masonry unit is placed in the wall.

Each masonry unit shall be adjusted to its final position in the wall while the mortar is still soft and plastic enough to insure a good bond. If the position of the masonry unit is shifted after the mortar has stiffened, or bond is broken or cracks are formed, the masonry unit shall be relaid in new mortar.

Masonry units shall be cured and dried before being used and surface shall be clean and free from dirt when laid in the walls. Masonry units shall not be wetted before being used but shall be laid dry.

510.2 MORTAR JOINTS

Mortar joints shall be straight, clean, smooth, and uniform in thickness and, unless otherwise noted or indicated on the Plans, shall be tooled slightly concave. Joint thickness to be 3/8-inch both vertical and horizontal unless otherwise shown. Where fresh masonry joins totally or partially set masonry, the set masonry shall be cleaned and roughened before laying new work.

510.3 JOINT REINFORCEMENT

Longitudinal wire joint reinforcement shall be lap spliced 75 wire diameters.

Longitudinal wires shall rest in the approximate centers of the mortar beds and shall have not less than 5/8-inch mortar cover on the exposed face.

Intersecting masonry walls shall be provided with prefabricated joint wire reinforcement tees. Intersecting wall joints shall be raked 1/2-inch and caulked.

510.4 BOND PATTERN

Bond pattern shall be as indicated on the Plans. Where no bond pattern is shown, the wall shall be laid up in a straight, uniform course with regular running bond.

510.5 GROUTING AND VERTICAL REINFORCEMENT

All spaces and cells containing vertical bar reinforcement shall be filled solidly with grout. Vertical cells containing bar reinforcement shall be filled solidly with grout in lifts not exceeding 8 feet in height. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1-1/2 inches below the top of the uppermost unit.

Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout where such lift or pour of grout is in excess of 4 feet in height. Any overhanging mortar or other obstruction or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed after inspection and before grouting. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement. Bars shall be held in position by steel wire bar positioners or tied to dowels with wire ties.

Vertical reinforcing bars shall be centered in the cells. Where bars are spliced, the splice shall not be less than 50 bar diameters and

footing dowels shall lap the vertical reinforcing bars 50 bar diameters. After grout has been placed, it shall be consolidated by rodding or by use of an immersion vibrator designed for the purpose.

Reinforcing steel shall be in place and reviewed by the Engineer before grouting shall begin.

#### 510.6 BOND BEAMS

Bond beam units shall be installed where indicated on the Plans. Bond beams shall be made up of special bond beam block with horizontal bar reinforcement. Horizontal bar reinforcement shall be solidly grouted in place. Bar reinforcement shall be continuous through control joints. Openings in the bottom of bond beams shall be provided with wire mesh to support the grout.

#### 510.7 CUTTING OF MASONRY UNITS

All necessary cutting of concrete masonry units to form chases, etc. for anchorage or other appurtenances shall be required. All cutting and fitting of exposed block units shall be done with a power driven carbide-tipped or diamond disc blade saw.

#### 510.8 CONTROL JOINTS

Control joints shall be as indicated in the Plans or as specified. They shall be full height and continuous in appearance, although bond beams and bond beam reinforcing bars shall be continuous through the joint. The control joint shall be caulked and shall be mortar joint in appearance. Fill material for control joints shall be premolded, wide flange control joint filler as specified elsewhere herein. Caulking shall also be as specified elsewhere herein. All joints shall be caulked to produce a weathertight structure.

#### 510.9 ANCHOR BOLTS

A 6-inch minimum width of grouted hollow masonry shall be provided all around anchor bolts and other attachment locations. Anchor bolts shall be held in place by a template to assure precise alignment of anchor bolts. Cutting, reaming or other means of accommodating misaligned anchor bolts in support angles will not be accepted.

#### 510.10 HANDLING OF MASONRY UNITS

All masonry units shall be transported and handled in such manner as to prevent chipping and breakage. Storage piles, stacks, or bins shall be located to protect materials from heavy traffic. Chipped, cracked, or otherwise defective units shall be removed from the work. Any unit that is chipped, cracked, broken, or otherwise defective, whether before or after setting, will be rejected and shall be removed and replaced.

#### 510.11 TIES

Where two or more units are used to make up the thickness of a wall, the units shall be bonded with 3/16-inch diameter galvanized steel rods or metal ties of equivalent stiffness embedded in the horizontal joints. Rods shall be bent in a rectangular shape. There shall be one metal tie for not more than each 4-1/2 square feet of wall area. Ties in alternate courses shall be staggered and the maximum vertical distance between ties shall not exceed 18 inches and the maximum horizontal distance shall not exceed 36 inches.

#### 510.12 ENCLOSURES

Where concrete masonry is to enclose conduits, pipes, stacks, ducts, and similar items; chases, cavities, and similar spaces shall be constructed as required, whether indicated on the Plans or not. Openings around flush mounted electrical outlet boxes including the flush joint above the box, shall be pointed with mortar. No such work shall be covered until advised that work has been inspected and tested.

#### 510.13 PATCHING

Patching of exposed concrete masonry units shall be done at the conclusion of the general work and shall be done in such a manner that the patching will be indistinguishable from similar surroundings or adjoining work.

#### 510.14 PROTECTION OF MASONRY

Temporary protection shall be provided for all exposed masonry corners subject to injury. Concrete scum and grout stains on masonry shall be removed immediately. The wall shall be adequately braced against wind and other forces during construction, and bracing shall remain in place until the roof has been erected. When rain or snow is imminent, the tops of unfinished walls shall be fully covered and protected with waterproof paper, polyethylene, or other means accepted by the Engineer.

#### 510.15 WATER CURING

Masonry shall be protected against too rapid drying by frequently fogging or sprinkling so that walls will always be visibly damp for a period of not less than three days.

#### 510.16 MISCELLANEOUS

All items as required, including all anchors, flashings, sleeves, frames, structural steel, loose lintels, anchor bolts, miscellaneous iron, and all other items required shall be built in for a complete job.

510.17 CONTROL JOINT FILLER

Premolded joint filler shall be wide flange Rapid Poly-Joint manufactured by Dur-O-Wall; wide flange Vert-A-Joint manufactured by Vert-A-Joint Company; or equal.

510.18 CAULKING

All caulking for masonry control joints, around door jambs, window frames, at roof decks, and at other locations in masonry construction shall be done with a 1 part, nonsag, high performance, polysulfide base sealant. Caulking shall conform to requirements of Interim Federal Specification TT-S-00230C, Type 2, Class A, and shall be Chem Calk 100 by Woodmont Products, Inc.; PRC 7000 by Products Research and Chemical Corp.; or equal. Color shall be selected by the Engineer from manufacturer's standard colors.

Application, including necessary primer and backer rod, shall be per manufacturer's recommendations. Sealant shall not be applied on wet or frosty surfaces or when surface temperature is above 130 degrees F. The depth of sealant in a joint shall not be greater than its width nor less than 1/4-inch. Sealant depths shall be as follows:

| <u>Joint Width</u>   | <u>Sealant Depth</u> |
|----------------------|----------------------|
| 1/4 inch to 3/8 inch | 1/4 inch             |
| 1/2 inch to 1 inch   | 3/8 inch             |

510.19 PAYMENT

Payment for concrete block masonry will be made in conformity with the terms of the Contract and will be made at the unit price bid for Item 510-1, Concrete Block Masonry.

The Contract price paid for concrete block masonry shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all work involved in constructing and furnishing concrete block masonry complete in place as indicated on the Plans, and as specified.

515 STRUCTURAL AND MISCELLANEOUS METALS

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

515.1 GENERAL

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

Aluminum and miscellaneous nonferrous metals  
Anchors and anchor bolts

Bolts  
 Cast iron frames and covers  
 Grating and frames  
 Hatches  
 Ladders  
 Manhole frames and covers  
 Metal roof decking  
 Miscellaneous aluminum  
 Miscellaneous cast iron  
 Miscellaneous metal items shown on the Plans or specified  
 Miscellaneous structural steel  
 Pipe handrails, pipe sleeves, inserts, and gates  
 Structural Steel  
 Sheet metalwork  
 Stairs and treads  
 Stop plank grooves  
 Supports for mechanical equipment  
 Tread plates and frames

515.2 MATERIALS

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

| <u>Item</u>                            | <u>ASTM<br/>Standard<br/>No.</u> | <u>Class, Grade,<br/>Type or Alloy<br/>No.</u> |
|--|----------------------------------|--|
| <u>Cast Iron</u>                       |                                  |  |
| Cast Iron                              | A 48                             | Class 40B                                      |
| <u>Steel</u>                           |                                  |  |
| Galvanized sheet iron or steel         | A 446<br>A 525<br>A 526          | Coating G90<br>(min.)                          |
| Structural steel                       | A 36                             |  |
| Standard bolts, nuts, and washers      | A 307                            |  |
| High strength bolts, nuts, and washers | A 325                            |  |
| Tubing, cold-formed                    | A 500                            |  |
| Tubing, hot-formed                     | A 501                            |  |
| Black steel, sheet or strip            | A 569<br>A 570                   |  |
| Coil (plate)                           | A 635                            |  |
| Steel pipe                             | A 53                             | Grade B  |

### 515.3 STRUCTURAL ALUMINUM

The Contractor shall furnish and install all structural aluminum items in accordance with the Plans and Typical Details, and as specified. He shall provide all supplementary parts necessary to complete each item even though such work is not definitely covered by the Plans and Specifications. Their size, form, attachment, and location shall be such as to conform to the best of current practice.

#### 515.3.1 ALUMINUM LAYOUT

Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material.

A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be taken as 0.000013 per degree F.

#### 515.3.2 CUTTING ALUMINUM

Material 1/2-inch thick or less may be sheared, sawed, or cut with a router. Material more than 1/2-inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Edges of plates carrying calculated stresses shall be planed to a depth of 1/4-inch, except in the case of sawed or routed edges of a quality equivalent to a planed edge. Reentrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for unfinished bolts shall be not more than 1/16-inch larger than the nominal bolt diameter. All holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal.

#### 515.3.3 ALUMINUM FORMING AND ASSEMBLY

Structural material shall not be heated, with the following exceptions:

Aluminum material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending or welding. Such heating shall be done only when proper temperature controls and supervision are provided to insure that the limitations on temperature and time are observed.

All chips lodged between contacting surfaces shall be removed before assembly.

#### 515.3.4 BOLTS FOR ALUMINUM

All bolts, nuts, and washers for bolting aluminum shall be Type 304 or Type 316 stainless steel of sizes indicated on the Plans, coated as specified herein.

#### 515.3.5 WELDING ALUMINUM

This Specification shall apply to both field and shop welding operations. The general recommendations and regulations specified in the American Welding Society Specifications D1.1, "Structural Welding Code," apply as well to 6061-T6 structures. Detail requirements in the above Specifications apply only to steel structures. Detail requirements for welding aluminum alloy 6061-T6 shall be as specified in the following paragraphs.

Filler rod metal for welding shall be aluminum alloy welding rods conforming to the requirements of AWS A 5.10 and shall be AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.

Welding of any structure which is to be anodized shall be done using filler alloy rods which will not discolor when anodized. ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556 filler alloy rods shall be used.

The welding process and welding operators shall both meet a qualification test. The method of qualification shall conform to the method described in the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications," Part B. Aluminum alloy 6061-T6 shall be used for the qualification test plates. Operators shall be qualified on the basis of bend tests and a fillet weld soundness test.

Dirt, grease, forming or machining lubricants, or any organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding shall be required when the inert gas tungsten arc welding method is used. This may be done by etching or by scratch brushing. The oxide coating may not need to be removed if the welding is done with the automatic or semiautomatic inert gas shielded metal arc.

Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining, or shearing may be used.

Any welding of aluminum shall be done using a nonconsumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used.

#### 515.4 GRATINGS

Except as otherwise specified or indicated on the Plans, grating shall be aluminum grating supported on aluminum shelf angles as indicated on the Plans. All surfaces of shelf angles, rebates, and anchors in contact with concrete shall be coated in accordance with these Specifications.

Grating shall cover the areas indicated and detailed on the Plans. Where grating is indicated over an opening, it shall cover the entire opening, unless specifically noted or detailed otherwise. The top surfaces of grating sections adjacent to each other shall be in the same plane.

Aluminum plate or angles shall be installed where required to fill openings at changes in elevation and at openings between equipment and grating. Angle stops shall be installed at ends of grating to prevent grating from sliding out of rebate.

There shall be not more than 1/8-inch clearance between the ends of the grating and the inside face of the vertical leg of the shelf angles. The horizontal bearing leg of the shelf angle shall not be less than 2 inches. Ends of grating and cutouts shall be banded. The width of the end band of the grating shall be 1/4-inch less than the depth of the grating with the top of the grating and the top edge of the banding flush. The width of cutout banding shall be full-depth of grating.

Cutouts in the grating shall be provided where required for equipment access or protrusion, including valve operators or stems, and gate frames. Edges of cutouts shall be banded with aluminum material similar to end banding.

Where an area requires more than one grating section to cover the area, adjacent grating sections shall be clamped together at the 1/4 points with acceptable fasteners.

The Contractor shall furnish to the Engineer calculations from the grating manufacturer showing that the grating will meet the load-bearing and deflection provisions of the specifications for each size of grating and for each span. The Contractor shall, if requested by the Engineer, test under full load one section of each size of grating for each span length involved on the job, to show compliance with these Specifications. A suitable dial gauge shall be provided by the Contractor for measuring deflections. Grating shall be fabricated in units which do not exceed 50 pounds each.

##### 515.4.1 ALUMINUM GRATING

Aluminum grating shall be supported on aluminum shelf angles as indicated on the Plans.

Gratings, shelf angles, and anchors shall be of 6061-T6 or 6063-T6 aluminum alloy, except that cross bars may be of 6063-T5 aluminum alloy.

Aluminum grating shall be of such bar size and spacing that, as determined by the manufacturer, the grating will support a uniform loading of 180 pounds per square foot on the entire area of the grating, using an extreme fiber stress of not more than 12,000 pounds per square inch, and that the maximum deflection under this loading will not be more than 1/240 of the clear span of the grating. The spacing of the main grating bars shall not be more than 1-1/8 inches clear between bars. Minimum depth of grating shall be 2 inches.

Grating shall be Irving Aluminum I-Bar manufactured by IKG Industries, Nashville, Tennessee; I-Bar as manufactured by Seidelhuber Metal Products, Inc., San Carlos, California; or equal.

#### 515.5 ANCHOR BOLTS AND INSERTS

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

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

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

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

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

##### 515.5.1 INSTALLATION

Unless indicated otherwise on the Plans, anchor bolts shall be embedded not less than 12 diameters and shall have a head or a hook not less than 4 diameters in length. Where indicated on the Plans, anchor bolts shall

be set in metal sleeves having an inside diameter approximately 2 inches greater than the bolt diameter and not less than 12 bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted in place.

#### 515.5.2 CONCRETE ANCHORS

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

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

Concrete anchors shall have the following minimum embedment lengths:

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

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

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

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

#### 515.6 FLOOR ACCESS DOORS

Exterior type floor access doors shall be Type JD-AL Special, as manufactured by the Bilco Company; GT or AM, as manufactured by Babcock-Davis Associates, Inc.; or equal.

Door leaf shall be aluminum diamond plate capable of withstanding a live load of 300 pounds per square foot. Channel frame shall be 1/4 inch aluminum with an anchor flange around the perimeter. An extruded neoprene membrane shall be provided to provide a weathertight seal. Doors shall be equipped with a minimum of two heavy forged brass hinges with stainless steel pins, spring operators to afford easy operation, and an automatic hold-open arm with release handle. A snap lock with removable handle shall be provided. A 1-1/2 inch drainage coupling shall be located in the channel frame. Factory finish shall be mill finish with shop coating applied to exterior of the frame in accordance with these Contract Documents. Size and location shall be per Plans. Installation shall be in accordance with manufacturer's instructions.

515.8      PAYMENT

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

Payment for all miscellaneous metal except temporary pedestrian bridge, special aluminum hatches and jib crane will be made at the lump sum price bid for Item 515-1, Miscellaneous Metal.

Payment for temporary pedestrian bridge will be made at the lump sum bid for Item 515-2, Temporary Pedestrian Bridge.

Payment for special aluminum hatches will be made at the lump sum price bid for Item 515-3, Special Aluminum Hatches.

Payment for jib crane will be made at the lump sum price bid for Item 515-4, Jib Crane.

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

520      ORNAMENTAL IRON FENCE

The work under this section consists of furnishing and installing ornamental iron fence on the bridge and approach barrier walls. Fence shall be comprised of individual vertical pickets mounted on horizontal rails in panel lengths not greater than 10'-1" in length. Pickets shall be made of 3/4 inch square tube or bar stock. Pickets shall be 4-1/2 inches center to center. Individual pickets shall be supported by no less than two 1-1/2 inch square tube horizontal rails. Panel shall be supported by vertical posts made of 3-inch square tube.

Panels, posts, anchor plates and all hardware shall be hot dipped galvanized in accordance with ASTM A 153 with a zinc content of not less than 0.90 oz/sf (G-90). Galvanizing shall be by the dry process with pre-flux applied directly to the steel prior to galvanizing.

Payment for this item will be made at the contract unit price bid per linear foot for Item 520-1, Ornamental Iron Fence.

601.2.8 DEWATERING TRENCHES

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

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

610 WATERLINE CONSTRUCTION

Waterline construction shall be in accordance with MAG Section 610 and 750.

Payment shall be made at the unit prices bid for Items 610-1 through 610-5.

610.8 FIRE HYDRANTS

Relocated fire hydrants shall be installed in accordance with MAG Section 610.8. Piping and valves from the point of extension to the new location shall be new material.

No separate pay item shall be contained in the Proposal for relocating fire hydrants. This operation shall be included in the price bid for attendant piping and valves.

611 DISINFECTING WATER MAINS

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

615 SEWER LINE CONSTRUCTION

Sewer line construction shall be in accordance with MAG Section 615.

Payment shall be made at the unit prices bid for Items 615-1 through 615-4.

618      STORM DRAIN CONSTRUCTION WITH CONCRETE PIPE

Concrete pipe storm drains shall be constructed in accordance with MAG Section 618.

Payment shall be made at the unit price bid for Items 618-1 and 618-2.

625      MANHOLES

Manholes shall be constructed in accordance with MAG Section 625.

Payment shall be made at the unit prices bid for Items 625-1 through 625-3.

630      TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATERLINES

Tapping sleeves, valves, and valve boxes on waterlines shall be constructed in accordance with MAG Section 630.

Payment shall be made at the unit prices bid for Items 630-1 through 630-5.

750.3      DUCTILE IRON WATER PIPE JOINT REQUIREMENTS

Restrained joints for ductile iron pipe shall be per MAG Standard Detail 302, or alternate method, as approved by the Engineer.

787.3      WATER, SEWER AND SURVEY FRAME AND COVER, MAG DETAIL 270

The bearing surfaces of the frame and cover shall be machined, tolerance  $\pm 1/32$  inch, so that the cover seats firmly on the frame without rocking.

787.3.1      ALUMINUM MANHOLE COVERS

The City of Phoenix Water and Wastewater Department has the following stated policy "MAG Standard Detail 425 - 24" Aluminum Manhole Frame and Cover is not approved by the City of Phoenix."

## DIVISION 12

### PUMPS

#### 120000 GENERAL

The Contractor shall furnish, install, and test all pumps as indicated on the Plans, or as specified herein. It is the intent of these Specifications to obtain pumps of heavy-duty construction for heavy-duty continuous service or for intermittent service, whichever imposes the most severe service on the pump. Pumps will be installed at an elevation of approximately 1,200 feet above sea level.

Each pump shall be furnished as a complete, ready-to-install unit by a single supplier, including but not limited to pump, motor, mountings, and (if so specified and equipped) variable speed drive, engine, and/or drive shaft assembly.

Pumps that have mechanical defects or do not meet the range of head-capacity characteristics, horsepower, efficiency, and vibration requirements will be rejected after testing and shall be replaced without additional cost to the Owner for furnishing, removal, reinstallation, and retesting. Mechanical defects shall include excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive bearing heating, defective materials, including materials that do not conform to the Specifications, improper fitting of parts, and any other defect which will in time damage the pump or unreasonably impair the efficiency of the pump.

#### 120001 CONSTRUCTION

No pump will be accepted by the Engineer for construction until the Contractor has submitted to the Engineer for acceptance sufficient literature, detailed specifications, and drawings indicating dimensions, make, style, speed, size, type, horsepower, full-load amps, head-capacity, efficiency, NPSH curves, specific materials used, design features, weights, and any other information required.

Any bronze used in the manufacture of any pump shall not contain more than 2 percent aluminum nor more than 6 percent zinc.

Impellers, cases, seals, shafts, bearings, and any other item which does not comply with the Specifications as to their metallurgy, material, or hardness shall be replaced without additional cost to the Owner for new parts, removal, and replacement. Except for submerged or special service pumps, or as accepted by the Engineer, pumps or adjacent piping shall be tapped at the suction and discharge for pressure gauges. Where packing gland drains are required or where water flushing or sealing of packing glands or mechanical seals is specified or shown, the Contractor shall furnish and install all piping and valves necessary.

#### 120002 INSTALLATION

Before installation, the Contractor shall furnish three sets of installation instructions and three sets of lubrication instructions for each type of pump. These instructions shall include detailed instructions for adjustment and recommendations for the proper type of lubricant.

Pumps shall be installed and adjusted as specified and in accordance with the manufacturer's recommendations and in such manner that connecting piping will not impose any strain whatever on any pump. Pumps shall be set upon level, fully grouted foundations, so that connecting flanges, screwed connections, or flexible connections will meet without strain or distortion. Pump foundation pads shall be doweled and keyed to the floor slab upon which it rests.

#### 120003 MOTORS

Motors shall be in accordance with the provisions of DIVISION 14 in addition to the following provisions and characteristics specified hereinafter.

Motors, as furnished and installed, shall be of sufficient horsepower rating so that the rated horsepower and full-load amps will not be exceeded at any point on the pump curve within the specified operating range of the pump. The operating range shall be that part of the pump curve within the limits specified.

#### 120004 TESTS

Each pump and driver, unless otherwise specified, shall be field tested for compliance with these specifications as to head-capacity, and horsepower. In addition, when so specified, each pump shall be test run at the place of manufacture and certified performance curves and other required data shall be submitted to the Engineer for acceptance before the pump is delivered to the jobsite. Unless otherwise specified, the Contractor shall furnish all manpower, facilities, power, and equipment required for making tests. Field tests and manufacturers' tests shall be conducted in accordance with the latest requirements of the Hydraulic Institute Standards.

#### 120005 VIBRATION

Vibration shall be tested with a Starret vibrometer or a vibrometer acceptable to the Engineer.

The vibration limits of pumps shall be as described in the Hydraulic Institute Standards except that peak-to-peak vibration amplitude shall not exceed 2 mils, unless otherwise specified, for any frequency at any distance from base to point of measurement. It shall be the responsibility of the manufacturer to dynamically balance the pump and motor, to reinforce, stiffen, or support the pump casing, frame, pedestal, or shafting to keep vibration within the limits as described herein.

120560. NONCLOG CENTRIFUGAL PUMPS - SUBMERSIBLE

The Contractor shall furnish and install, complete in place in operable condition, submersible type nonclog centrifugal wastewater pumps. The pumps shall be installed as indicated on the Plans, and as specified herein.

The pumps shall be as manufactured by Davis EMU, Flygt Corporation, Gorman-Rupp Corporation, or equal.

Each pump shall be rated to deliver not less than 1,370 gpm at 32 feet total head, with efficiency not less than 55 percent and speed not more than 1,800 rpm. Each pump shall be capable of operation at all points on its curve between 850 gpm and the flow corresponding to 17 feet total head, with available net positive suction head (NPSHA) of 30 feet. The pump shall operate over this range without excessive noise or vibration, without exceeding motor horsepower rating, and free of cavitation or any other mechanical defects.

Each pump unit shall be designed for operation for not less than 30 minutes with the motor completely unsubmerged, without damage or overheating of any kind. Each pump unit shall be designed for intermittent operation of 10 starts per hour without harmful effect.

The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 60 feet.

The pump casing, motor housing, bearing housing and impeller shall be constructed of cast iron. All exterior fasteners shall be stainless steel. Pump shaft shall be stainless steel.

The impeller shall be nonclogging design capable of handling solids, fibrous material, heavy sludge, scum, and other material found in normal wastewater applications. The maximum temperature will be 85 degrees F. The impeller shall be statically and dynamically balanced for quiet, vibration-free operation. The impeller shall be slip fit to the shaft and key driven. A wear ring system shall be provided for efficient sealing between impeller and volute and shall be replaceable. The impeller shall pass up to 3-inch spherical solids.

The pump shall be provided with a tandem mechanical rotating shaft seal system. Upper seals shall run in an oil reservoir. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven rotating tungsten carbide ring. The upper seal unit shall contain one stationary tungsten carbide ring and one positively driven rotating carbon ring. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. Shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units, are not acceptable.

The mechanical seal oil reservoir shall be fitted with a moisture detector which shall be wired into the control panel to alarm the presence of water.

The pump motor shall be housed in an air filled or oil filled, watertight motor housing with a removable motor cap for easy access to stator wires, and with a watertight seal between stator lead and motor compartments. The motor shall be NEMA Design B for continuous duty with Class "F" -155 degrees C insulation stainless steel shaft with heavy-duty long life ball bearings. The stator windings shall be furnished with thermal sensors, one per phase, for thermal protection of the motor. These shall be used in conjunction with and supplemental to external motor overload protection, and shall be wired into the control panel.

The motor shall have the following characteristics:

|                            |       |
|----------------------------|-------|
| Horsepower - not less than | 20    |
| Speed - rpm, maximum       | 1,800 |
| Volts                      | 460   |
| Phase                      | 3     |
| Hertz                      | 60    |
| Service Factor             | 1.10  |

The pump motor shall be sparkproof and explosion-proof for Class 1, Group D, Division 1 hazardous location.

Pump motor cable shall be suitable for submersible wastewater pump applications. Cable sizing shall conform to National Electric Code Specifications for pump motors, and shall be of adequate size to allow motor voltage conversion without replacing cable.

A sliding guide bracket shall be provided to allow the pump unit to be raised or lowered on guide rails to automatically be connected and disconnected from its mating discharge connection permanently installed in the wet well. The pump shall be easily removed and installed for inspection and service. Each pump shall be furnished with lifting stainless steel cable of adequate strength and length. Each pump shall be furnished with upper guide holder and liquid sensor cable holder. Lower guide holders shall be firmly and rigidly connected to discharge connection. Guide bars shall be stainless steel, 2-inch diameter Schedule 40 pipe or 2-inch "T" bar, and shall not support any weight of the pump. Guide bars shall be stabilized with intermediate supports of heavy-gauge stainless steel attached to the discharge risers or wet well structure at not greater than 8'-0" centers.

Pump controls shall be as specified in DIVISION 16.

Payment for pumps will be made at the unit price bid for Item 1200-1, Pumps.

## DIVISION 14

### MECHANICAL EQUIPMENT

#### 140000 GENERAL REQUIREMENTS

Specifications contained in this section shall apply to all items of mechanical equipment the same as if these Specifications were contained in the individual section for the equipment in this Division, or any other Division herein.

All items of equipment shall be the product, modified as specified herein, of a manufacturer experienced in the design, construction, and operation of equipment for the purpose required, and who shall have established a record of successful operation of such equipment manufactured or produced by them. When two or more units of equipment for the same purpose are required, they shall be products of the same manufacturer. Equipment shall be made up of parts which are designed to act as a unit, and the manufacturer shall guarantee that when the component parts are assembled into the final unit, these parts will fit and operate satisfactorily.

Except as otherwise provided, the responsibility of the equipment manufacturer shall extend to the selection and mounting of gear drive units, motors or other prime movers, accessories and auxiliaries required for proper operation.

#### 140010 SUBSTITUTION OF EQUIPMENT

Equipment shall be readily adaptable for installation and operation in the structures as indicated on the Plans.

Equipment of equal quality and performance may be substituted for those indicated or specified, except as otherwise provided for in the Proposal and Contract. Any revisions to structures, piping, electrical, or other work as a result of the substitution shall be acceptable to the Engineer, and the cost of all such revisions shall be borne by the Contractor.

All specific requirements of these Specifications must be adhered to, and modifications shall be made in the specified model of manufacturer's equipment to make it conform to the specific requirements of these Specifications if the standard product does not fulfill all requirements.

#### 140011 SHOP DRAWINGS

Complete assembly, support, and installation drawings together with detailed specifications and/or catalog data covering equipment, parts, material used, weights and outline dimensions, controls, and other accessories forming a part of the equipment furnished shall be submitted

to the Engineer for review. Methods of anchoring with consideration of seismic design for restraint per Uniform Building Code and/or mechanical stops shall be included in the submittals. Size, location, and spacing of foundation bolts, including vertical and/or horizontal adjustments available for installation and future adjustment shall be clearly indicated.

#### 140012 OPERATION AND MAINTENANCE MANUALS

The Contractor shall deliver to the Engineer four (4) sets of manufacturer's operation and maintenance manuals covering each piece of equipment or equipment assembly furnished under this Contract. Installation of equipment shall not begin until the above required manuals covering that part of the equipment have been supplied to the Engineer.

Each manual shall be bound into multiple volumes, each volume to be complete with an index bound into a heavy post binder with the index of each protected by a laminated clear plastic cover. The Contractor shall not deliver any O&M manuals until all required materials have been assembled and bound as specified.

The operation and maintenance manuals shall include, as a minimum, the following data for each item of mechanical, electrical, and instrumentation equipment. Information not applicable to equipment installed in the work shall be excluded.

1. Recommended start-up and trouble shooting procedures
2. Disassembly and reassembly instructions
3. Lubrication schedule
4. Recommended preventative maintenance procedures and schedules
5. Recommended spare parts
6. Parts lists, by generic title and identification number, complete with section views of each assembly
7. Name, address, and telephone number of nearest supplier and spare parts warehouse

In addition, the O&M manuals shall contain reproducible prints of the Contract record wiring diagrams, schematics, and installation drawings required under the Electrical and Instrumentation Specifications.

#### 140013 MATERIALS AND WORKMANSHIP

All equipment shall be designed, fabricated, and assembled in accordance with the best modern practice in the manufacture of high grade machinery.

All parts and components of mechanical equipment shall be designed for satisfactory service under continuous duty without undue wear under the specified and indicated operating conditions for a period of not less than one year. Any part of mechanical equipment that shows undue or excessive wear or that fails due to wear under normal operating conditions within the first year of operation after final acceptance shall be considered as evidence of defective material or defective workmanship, and it shall be replaced by the Contractor with equipment or parts to meet the specified requirements at no cost to the Owner.

Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Materials shall be suitable for the service conditions to be encountered. Structural steel shall conform to ASTM A36. Iron castings shall be of tough, close-grained gray iron, free from blow-holes, flaws, or other imperfections and shall conform to ASTM A48. All mechanisms or parts shall be amply proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication and erection.

Unless otherwise specified, all materials shall conform to the structural and miscellaneous standards of the American Institute of Steel Construction.

Bronze which will be in contact with water or any liquid, used in the manufacture of any equipment shall not contain aluminum nor more than 6 percent zinc, and shall conform to ASTM B-62, or equivalent.

Surfaces requiring painting or coating for corrosion protection shall be smooth, free from sharp edges, burrs, and projections, and shall have all welds ground smooth and all edges and corners of structural members rounded.

All steel bars, shapes, and plates shall be clean and straight before being worked. Straightening or flattening, if necessary, shall be done by a process and in a manner that will not injure the metal. Sharp kinks or bends shall be cause for rejection. Steel that has been heated partially shall be annealed, unless it is to be used in minor parts. Finished members shall be true to line and free from twists, bends, and other joints.

Tolerances and clearances shall be as indicated on the Shop Drawings and these tolerances and clearances shall be closely followed to secure proper operation of the equipment.

Unless otherwise specified, piping, fittings, and valves shall be as specified elsewhere herein. All flanges on equipment and appurtenances furnished shall conform in dimensions and drilling to ANSI B16.1, Class 125 or 150, or as required.

Field welding, where required, shall be as specified elsewhere herein.

#### 140013.10 BEARINGS

Unless otherwise specified, all equipment bearings shall be oil or grease lubricated, ball or roller antifriction type of standard manufacture. Bearings shall be conservatively designed to withstand all stresses of the service specified. Each bearing, except as otherwise noted, shall be rated in accordance with the latest revisions of Anti-Friction Bearing Manufacturer's Association's (AFBMA) Methods of Evaluating Load Ratings of Ball and Roller Bearings for B-10 rating life of 40,000 hours.

All grease lubricated bearings, except those specified to be factory sealed lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings of the standard hydraulic type. Extension tubes shall be provided for easy access.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 40 degrees C and shall be equipped with a filler pipe and an external level gauge. Fittings for pressure lubrication shall be 1/4-inch straight-type.

To avoid work hardening or "Brinelling" damage from vibration, bearings shall be separately packed or otherwise suitably protected during transport.

#### 140014 PROTECTION OF EQUIPMENT

All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. All equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to final acceptance of the work shall be repainted to meet Specification requirements.

#### 140015 INSTALLATION

The Contractor shall take measurements from his work at the installation sites, verify all subcontractor's drawings and be responsible for the proper installation of the equipment within the available space as specified and indicated on the Plans, and he shall secure the acceptance by the Engineer for any variations before making any changes.

The Contractor shall obtain and follow installation instructions and other recommendations from the equipment manufacturers. Manufacturer's recommendations as to grout spaces required, type of grout to be used, and tolerances for level and alignments, both vertical and horizontal, shall be obtained and followed.

Skilled workmen experienced in installation of the equipment or similar equipment shall be used. Applicable special tools and equipment, such as precision machinist levels, dial indicators, and gauges shall be utilized as required in the installations. The work shall be accomplished with good workmanship to produce satisfactory equipment installation free of vibration or other defects. Whenever applicable, the Contractor shall obtain the service of a manufacturer's representative specifically trained in erection of his equipment to supervise the installation.

Metalwork to be embedded in concrete shall be accurately placed and held in correct position while the concrete is being placed. The surface of all metalwork to be in contact with concrete shall be thoroughly cleaned immediately before concrete is placed. All anchor bolts shall be cast in place when the concrete is placed. Anchors shall be installed as recommended by the manufacturer to develop the full strength of the bolt. No use shall be made of expansion shields.

Anchor bolts for pumps and blowers, and such other equipment where so specified, shall be encased in metal tubing having an inside diameter not less than two times that of the bolt. Pump and other similar foundations shall be left 1-inch below the grade of machine base unless otherwise noted on the Shop Drawings. After the proper setting of machine for alignment and grade, the recess below the base together with recess between the anchor bolt and the metal tube shall be grouted and carefully finished with an acceptable quick setting, nonshrink, rust-prohibitive mortar.

Prior to installation of equipment, all sacking and concrete preparation shall be completed, and the work area shall be maintained in a clean condition during the equipment installation.

Equipment not intended to vibrate during normal operation shall be rigidly attached to the foundation or other adequate support to prevent lateral and vertical displacement. Equipment intended to vibrate during normal operation shall be provided with isolators with mechanical stops which are securely anchored to foundation or other adequate support.

#### 140016 BASES AND BEDPLATES

A heavy cast iron or welded steel base shall be provided for each item of equipment which is to be installed on a concrete pad or slab. Equipment assemblies, unless otherwise specified or indicated on the Plans or accepted Shop Drawings, shall be mounted on a single, heavy, cast iron or welded steel bedplate. Bases and bedplates shall be provided with machined support pads, dowels for alignment of mating or adjacent items,

adequate openings to facilitate grouting, and openings for electrical conduits. All seams and contact edges between steel plates and shapes shall be continuously welded and ground smooth. The bottom of all bases and bedplates shall have at least two coats of zinc chromate primer before installation or grouting.

#### 140016.10 JACKING SCREWS AND ANCHOR BOLTS

All equipment shall be anchored to supporting members by bolts or other connections to accommodate all operating forces and satisfy the seismic restraint requirements of the Uniform Building Code. Anchors shall provide resistance to a lateral force of at least 0.10 times the weight of the equipment, including its contents. Equipment installed on flexible mounts shall be given special consideration with design calculations including resonance determinations, submitted for review with Shop Drawings.

Jacking screws shall be provided in the heavy equipment bases and bedplates and where required elsewhere to aid in leveling prior to grouting.

Equipment suppliers shall furnish anchor bolts, nuts, washers, and sleeves of adequate design as required for proper anchorage of the bases and bedplates to the concrete bases. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1 inch of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.

All bolts and anchor bolts shall be of Type 316 stainless steel.

#### 140016.20 GROUTING

After assembly and installation on the concrete base, each unit shall be leveled and aligned in place but not grouted until connecting piping has been fitted and aligned. Equipment bases shall not be grouted nor foundation bolts finally tightened until all piping connections are complete and in satisfactory alignment with no strain transmitted to the equipment. Adjacent couplings shall be loosened to determine if pipe strain exists immediately before foundation is grouted. Concrete surfaces shall be cleaned and thoroughly wetted before grout or mortar is placed. To bond mortar or grout to concrete which has reached its initial set, the surface of the set concrete shall first be coated with epoxy liquid polysulfide bonding agent. Nonshrink grout and bonding agent shall be as specified elsewhere herein of these Specifications. The grout shall extend to the edge of each base or baseplate and shall be beveled at 45 degrees all around the unit and the finished surface shall not pond water within the grouted area. After grout has set, jacking screws shall be removed and nuts or anchor bolts shall be tightened, followed by an overall check on leveling and alignment.

## 140017 LUBRICATION

### 140017.10 LUBRICANT

The Contractor shall furnish all mechanical equipment with its proper supply of correct lubricant for starting, testing, and adjustment. All lubricants shall be as recommended by the equipment manufacturer. The Contractor shall limit the various types and brands of lubricants by consolidating, with all the equipment manufacturers' approval, into the least number of different types and brands. Before starting, testing and adjusting equipment, the Contractor shall provide the Owner with four copies of a list showing the proper lubricants, after consolidation, for each item of mechanical equipment and the estimated quantity of lubricant needed for a full year's operation, assuming all equipment to be operating continuously.

### 140017.20 FITTINGS

All lubrication fittings shall be brought to the outside of all equipment so they are readily accessible from the outside without the necessity of removing covers, plates, housing, or guards. Fittings for underwater bearings shall be brought up above the surface of the water with 1/4 inch stainless steel tubing and mounted on the edge of the structure above. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible. They shall not be individual fittings field-mounted together, but use shall be made of factory-mounted multiple fitting assemblies.

## 140018 SAFETY REQUIREMENTS

All equipment furnished under these Specifications shall comply with all applicable Federal safety regulations, including OSHA regulations and also all applicable State and local safety regulations and codes.

All sprockets, belts, drive chains, gearing, couplings, and all other moving parts on drive assemblies shall be enclosed in removable safety enclosures in compliance with said safety regulations.

Safety guards shall be fabricated from 16 USS gauge or heavier galvanized or aluminum clad sheet steel or 1/2-inch galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories including bolts, shall be hot-dip galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

## 140019 PAINTING AND COATING

Prime and finish coating materials and procedures shall be as specified elsewhere herein, except where otherwise specified.

Machined, polished, and other ferrous surfaces and nonferrous surfaces which are not to be painted shall be coated with acceptable rust preventative compound.

#### 140020 NAMEPLATES

Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. The nameplate shall include manufacturer's name, equipment model number, identification tag number, drive speed, motor horsepower, and rated capacity. Nameplates for pumps shall also include rated total dynamic head and impeller size.

#### 140021 WARNING SIGNS

Permanent warning signs shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. Mounting details shall be in accordance with manufacturer's recommendations; location as acceptable to the Engineer.

Warning signs shall be 7 inches high by 10 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Copy shall read:

CAUTION  
THIS EQUIPMENT STARTS  
AUTOMATICALLY  
BY REMOTE CONTROL

#### 140022 SPECIAL TOOLS AND ACCESSORIES

The Contractor shall supply one complete set of any special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation manuals describing the use of each marked tool. All wrenches and spanners shall be of best quality, hardened steel forgings with bright, finished heads and with work faces dressed to fit nuts. Each set of tools shall be neatly mounted in a tool box of suitable design provided with a hinged cover.

#### 140023 INSTALLATION CHECKING, TESTING, AND OPERATOR INSTRUCTION

The Contractor shall operate all equipment and systems to show conformance with Specification requirements.

Where called for in the Detailed Specification of the item, or where required to secure satisfactory installation or operation, the Contractor shall furnish the services of experienced, competent, and authorized

factory trained representatives of the manufacturer or supplier of the items furnished. These representatives shall visit the site of work to perform the following tasks:

1. Inspect, check, and adjust if necessary, the items furnished and their installation.
2. Operate and field test the items furnished for proper operation.
3. Perform necessary field adjustments until the installation and operation comply with the Contract requirements.
4. Submit to the Engineer, through the Contractor, a written report indicating the items checked, adjustments made, results of measurements taken and tests made, and certification of the facility's readiness for operation.
5. Where called for in the Specifications, instruct the Owner's personnel in the operation and maintenance of the items furnished. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
6. Furnish such other services as are called for in the Specifications.

All moving parts of equipment and machinery shall be carefully tested for operation, and adjusted so that all parts move freely and function to secure satisfactory operation. Field performance tests of all process and pumping equipment, drive motors, including auxiliaries shall be made in accordance with the appropriate and approved test codes of the American Society of Mechanical Engineers, Hydraulic Institute Standards, NEMA and IEEE, latest editions.

Field testing shall be conducted after the project or system is substantially complete such that each item of equipment is ready for integrated operation with other equipment at the plant. Testing, measuring, and calibrating procedures shall be submitted to the Engineer for review and acceptance prior to start-up and field testing of equipment.

All equipment shall be tested continuously under actual or simulated operating conditions. The manufacturer's representative shall make all necessary field adjustments and correct defects in materials or workmanship during this test period.

The equipment shall be properly filled, by the Contractor, with oil and grease, and the Contractor shall furnish all power, personnel, chemicals, fuels, oil, grease, and auxiliaries necessary for initial testing of the equipment for proper operation, efficiency, and capacity.

After the 7-day acceptance test has been run by the Owner, and the results comply with the Contract requirements, the Contractor shall dowel the equipment in accordance with the manufacturer's recommendations.

The costs of all work performed in this Subsection by factory trained representatives shall be borne by the Contractor. When available, the Owner's operating personnel will provide assistance in the field testing.

The period of inspection, initial start-up operation, and field adjustment shall be as required to achieve satisfactory installation and operation of the items furnished. The period for instruction of the Owner's personnel shall be as called for in the individual Equipment Specifications.

#### 140070 MOTORS, GENERAL

Motors shall be manufactured in accordance with NEMA MG-1 Standards and shall be as specified herein or as specifically excepted in the individual equipment specifications.

#### 140071 MOTOR STANDARDS

Unless otherwise specified for specific application, motors shall be: Type - Induction, squirrel cage; Polyphase Design "B"; Environment Protection - Open, splashproof, with stainless steel rodent guards, encapsulated winding for motors less than 100 horsepower and sealed windings for 100 horsepower and above; Speed - Constant, where two speed are specified they shall be dual winding; Rating - 460 V, 3 phase, high efficiency, high power factor, 40 degrees C ambient, Class "B" insulation.

#### 140072 SPECIAL CONDITIONS

Altitude rating shall be the responsibility of the Contractor. Sound (noise) limits, when applicable, shall be as specified elsewhere. Aluminum frame motors must be individually reviewed for acceptance and they shall be manufactured with specially processed steel bearing inserts in each end shield and supplied with special long life bearings. Motors controlled by variable speed drive units shall each be protected by internal motor thermostats for overtemperature protection.

#### 140074 HORSEPOWER RATING

Motor horsepower ratings noted in individual equipment specifications or indicated on the Plans are estimates only and it is the responsibility of the equipment manufacturer and of the Contractor to coordinate and furnish motors, electric circuits, starters, and other equipment of ample horsepower capacity to operate the equipment furnished without exceeding the nameplate full-load current at rated nameplate voltage. Full-load amps information shall be furnished with submittal.

140075. PAYMENT

No separate payment will be made for this item. Payment for all work under this section shall be included in Item 1200-1, Pumps.

140700. ODOR CONTROL SYSTEM

140700.1. GENERAL

An odor control system shall be provided for removing hydrogen sulfide and organic odors which are vented from the wastewater lift station wet well. The system shall be modular, compact, and corrosion resistant, and shall be designed to contain 150 pounds minimum of IVP granular activated carbon for treatment of air up to a rate of 100 cfm.

The odor control system shall have the following general characteristics:

1. Construction shall be corrosion resistant.
2. Unit shall contain a minimum of 150 pounds of IVP granular activated carbon.
3. Unit shall contain no moving parts.
4. Unit shall provide continuous treatment.
5. Unit shall require no outside energy source.
6. Maximum head loss at 100 cfm shall be 14.0 inches water column.

140700.2. ACTIVATED CARBON

The activated carbon for use in the odor control system shall be virgin granular product, produced from bituminous coal and chemically impregnated with NaOH as manufactured by Calgon Carbon Corporation, or equal, suitable for control of wastewater odors. Approximately 150 pounds of IVP granular activated carbon is required per unit.

The carbon shall have the following performance specifications:

Carbon Substrate

|   |        |
|---|--------|
| CCl <sub>4</sub> Number, % by Weight<br>(per ASTM D-3467) | 60     |
| Iodine Number, Minimum                                    | 1,000  |
| Mean Particle Diameter, Minimum                           | 3.6 mm |

Impregnated Carbon

|   |                                    |
|---|------------------------------------|
| Apparent Density (1)  | 0.55 g/cc, Minimum                 |
| Hardness Number, Minimum  | 95                                 |
| Moisture, Maximum (2)   | 15%                                |
| Maximum Head Loss (W.C.) at 50 fpm<br>Linear Velocity (through a dense<br>packed bed) (3) | 1.9" W.C./Ft. Bed Depth            |
| H <sub>2</sub> S Breakthrough Capacity, Minimum (4)<br>Carbon                             | 0.12 g H <sub>2</sub> S Removed/cc |

- (1) As determined by ASTM D-2862 on a dry basis. The delivered apparent density will range from 0.55 to 0.64 g/cc.
- (2) Calculated on a total product basis.
- (3) Dense packing as defined by procedure for apparent density determination where a glass 100 milliliter graduated cylinder is filled through a funnel with 15/16 inches inside diameter stem at a uniform rate of not exceeding 1 milliliter per second. Pressure drop is measured across a 3-foot deep carbon bed, at least 5 inches in diameter.
- (4) The determination of H<sub>2</sub>S breakthrough capacity will be made by passing a moist (85% R.H.) air stream containing 1% H<sub>2</sub>S at a rate of 1,450 cc/min through a 19 millimeter diameter by 9-inch deep bed of uniformly packed activated carbon and monitored to 50 ppm breakthrough. Results are expressed in grams H<sub>2</sub>S removed per cc of carbon.

Payment for odor control will be made at the lump sum bid for Item 1407-1, Odor Control.

## DIVISION 15

### PIPING, VALVES, GATES, AND SPECIALTIES

#### 150000. GENERAL

DIVISION 15 applies to those applicable items located within the lift station compound (within the masonry fence) and force main in its entirety.

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

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

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

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

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

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

#### 150010 EXPOSED PIPING

Where not detailed, exposed pipe shall be installed in straight runs parallel to the axes of the structures. Pipe runs shall be horizontal

and vertical except that gravity drain lines shall be sloped down in the direction of flow not less than 1/8 inch per foot.

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

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

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

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

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

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

#### 150011 WALL AND SLAB PENETRATIONS

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

#### 150020 BURIED PIPING

All pipelines laid in open trenches shall conform to the MAG Uniform Standard Specifications, Part 600.

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

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

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

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

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

#### 150021 LAYING OF PIPE AND FITTINGS

In laying pressure pipelines, the deflection in a standard joint shall not exceed the manufacturer's recommendation. Horizontal and vertical deflections of not more than the recommended combined angle, including

curves as indicated on the Plans, shall be made by deflections in standard pipe joints within 10 feet of the indicated stations. Five degree beveled joints may be used. Deflections of more than 5 degrees shall require special bends or fittings. Departure from and return to established alignment and grade shall not exceed 1/16 inch per linear foot of pipe and at no point shall the maximum departure from established line and grade be greater than 1 inch.

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

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

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

#### 150025 LAYING OF DUCTILE IRON PIPE

Trenching, bedding, and backfill shall be in accordance with MAG Uniform Standard Specifications, Part 600.

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

#### 150027 LAYING OF PVC PIPE OR CPVC PIPE

Trenching and backfill shall be in accordance with MAG Uniform Standard Specifications, Part 600.

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

#### 150029 LAYING OF VITRIFIED CLAY PIPE

Trenching, bedding, and backfill shall be in accordance with MAG Uniform Standard Specifications, Part 600.

The handling, storage, and installation of vitrified clay pipe shall be in accordance with the requirements of ASTM C 12.

#### 150030 CLEANING AND TESTING

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

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

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

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

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

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

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

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

#### 150033 LIQUID PIPING TESTS

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

#### 150060 PIPING SCHEDULE

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

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

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

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

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

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

Sewage piping may be ductile-iron pipe, vitrified clay pipe, or concrete pipe.

Sludge piping may be asbestos-cement, vitrified clay pipe, or ductile-iron pipe. Ductile-iron pipe and fittings for sludge lines which may be steam cleaned shall not be cement lined.

Culvert pipe may be corrugated metal pipe or concrete pipe.

Chlorine liquid and gas piping shall be Schedule 80, ASTM A 106, Grade A.

#### PIPING SCHEDULE

| <u>Use</u>         | <u>Piping</u>                | <u>Joints/Fittings</u>       | <u>Test Pressure</u> |
|--------------------|------------------------------|------------------------------|----------------------|
| Drains Under Slabs | Cast iron soil               | Bell & spigot                | 20 feet              |
| Gravity Sewer      | Vitrified clay<br>ASTM C-700 | Rubber gasket                | 20 feet              |
| Pressure Sewer     | Ductile iron,<br>Class 50    | Mechanical joint,<br>flanged | 50 psi               |
| Vent               | PVC, Sch. 40                 | Solvent weld                 | 20 feet              |
| Potable Water      | Copper<br>ASTM B 88          | Soldered                     | 125 psi              |

#### 150070 CONNECTION TO IN-SERVICE LINES

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

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

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

#### 150100 DUCTILE-IRON PIPE

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

Ductile-iron pipe shall conform to the requirements of ANSI A 21.50 and ANSI A 21.51 (AWWA C 150 and AWWA C 151). Ductile-iron pipe fitted with threaded flanges shall conform to ANSI 21.15 (AWWA C 115). Unless indicated otherwise on the Plans, ductile-iron pipe shall be thickness Class 50.

### 150110 JOINTS

Where so indicated or specified, joints shall be made with flexible couplings or with mechanical couplings for grooved or shouldered end pipe. Unless otherwise noted, joints that are not buried in the ground and those that are indicated on the Plans or in the Specifications to be flanged shall be flanged joints. All other joints shall be mechanically restrained mechanical joints, or mechanically restrained push-on joints.\* Concrete thrust blocks shall be used only when specifically detailed or accepted by the Engineer. Mechanical joint, or push-on joint pipelines shall have flanges where necessary for valves and clean-out connections.

### 150111 FLANGED JOINTS

Flanges may be cast integrally with the pipe, in which case they shall conform to ANSI B 16.1 as to diameter, thickness, drilling, etc., or they may be screwed on the threaded ends of the pipe. Screwed-on flanges shall conform to ANSI B 16.1 as to material, diameter, thickness, drilling, etc., but shall have long hubs threaded specially for ductile-iron pipe. Screwed-on flanges shall be attached to the pipe by the pipe manufacturer, and after attachment the faces of the flanges and the ends of the pipe shall be refaced so that the end of the pipe will be even with the face of the flange and both will be perpendicular to the axis of the pipe. Bolt holes on the 2 flanges on a piece of pipe shall be in perfect alignment. Bolts shall conform to ANSI B 16.1 except that flanges underground, in concrete valve boxes, or in water may be cast-iron bolts and nuts, and all bolts and nuts under these conditions shall be painted with an asphaltic coating as specified in AWWA C 104, of at least 10 mils thickness.

Cast-iron bolts and nuts shall be made of material having at least 50,000 psi tensile strength. The cast-iron bolts used with mechanical joints will be acceptable.

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

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

### 150112 MECHANICAL JOINTS

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

### 150120 FITTINGS

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

#### 150130 LINING AND COATING

Except as otherwise specified, all ductile-iron pipe and fittings shall be lined with epoxy bituminous coating on surfaces prepared in accordance with the manufacturer's published recommendations, to a nominal thickness of 40 mils, but in no case less than 35 mils. Special attention shall be given to the lining of fittings. All lining shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.

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

#### 150140 HANDLING OF PIPE AND FITTINGS

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

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

#### 150160 CORROSION PROTECTION

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

#### 150170 TESTING

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

#### 150171 PRESSURE TEST

All pipelines shall be tested by subjecting each section to a pressure, measured at the lowest end of the section, of at least 125 percent of the class rating or design pressure of pipe under test.

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

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

See Section 150060, PIPING SCHEDULE, for test pressures.

#### 150172 LEAKAGE TEST

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

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

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

in which L = allowable leakage in gallons per hour.

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

D = nominal diameter of pipe in inches.

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

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

Connections to the existing pipelines or existing valves shall not be made until after that section of the new construction has satisfactorily passed the hydrostatic tests.

#### 150400 CAST-IRON SOIL PIPE AND FITTINGS

Where cast-iron-soil pipe is indicated on the Plans, it shall be as specified hereafter.

All junctions shall be made with sanitary tees or with wyes, with brass screw plug cleanouts at changes in direction in accessible places. Horizontal runs of pipe shall be supported at not over 5-foot spacing. Vertical pipes shall be installed in chases in the wall where the wall is plastered, and where the wall is not plastered, may be installed in chases in the wall, or may be run exposed. Vertical pipes shall be supported at the base and at least at each floor.

Pipelines shall be left thoroughly clean. Testing shall be in accordance with the plumbing codes requirements.

#### 150410 BURIED CAST-IRON SOIL PIPE

Cast-iron soil pipe buried in the ground shall be bell-and-spigot service weight cast-iron soil pipe conforming to the requirements of ASTM A 74. Joints shall be lead joints firmly packed with oakum and secured with not less than 1 inch of lead, well caulked, or shall be made by using positive double seal compression type gaskets conforming to ASTM C 564.

#### 150430 FITTINGS

Changes in pipe size shall be made with reducing fittings. All changes in direction shall be made by use of 45 degree wyes, half wyes, long sweep 1/4 bends, 1/5, 1/6, 1/8, or 1/16 bends, except that sanitary tees may be used on vertical stacks, and short 1/4 bends or elbows, 3 inches in size or larger, may be used on soil or waste lines where the change in direction of flow is from horizontal to vertical and on the discharge from water closets.

Cleanouts shall be the same size as the pipe, except that cleanout plugs larger than 4 inches will not be required.

#### 150440 COATING

All cast-iron soil pipe and fittings shall be coated inside and out with coal-tar pitch, except that the outside shall be uncoated when pipe and fittings are in exposed locations and are to be painted.

#### 150800 COPPER PIPE AND TUBING

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

Copper lines shall be neatly supported as indicated on the Plans or at such intervals as to prevent sagging. Tube shall be cut square with hacksaw or disc cutter and shall be reamed full size and burrs removed. If necessary, a sizing tool shall be used to correct any distortion. The outside surface of the end of the pipe and the inside surface of solder fittings shall be cleaned with steel wool until the metal is bright. Soldering flux shall be applied to the cleaned surfaces of pipe and fittings in a thin, uniform, complete coating. After the pipe has been inserted in the fitting as far as it will go, the fitting shall be twisted on the pipe to help spread the flux uniformly. The fitting shall be heated until it reaches the correct temperature to melt the solder. The flame shall then be removed and the solder applied to the edge of the fitting or to the solder hole in the fitting, if there is one, and the joint completely filled with solder. When the solder has congealed to a plastic state, the excess metal shall be removed with a cloth or brush. Joints shall not be quenched after soldering.

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

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

#### 150810 ASTM B 88 TUBING

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

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

Fittings shall be Hoke "Gyrolok," Crawford Fitting Company "Swagelok," or equal, or solder type forged or wrought copper. Solder shall be ASTM B 32, Alloy Grade 5A.

Copper pipe connected to ferrous pipe or valves, or other noncopper items shall be connected by means of dielectric insulating unions or fittings.

When making connections to meters or other devices having iron pipe size threaded fittings, special thread to tube adapters shall be used. Such adapters shall be Crawford Fitting Company "Swagelok," Hoke "Gyrolok," or equal.

#### 150830 INSTALLATION

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

Cuts shall be made with a tubing cutter, or with a 32-tooth hacksaw, and shall be square. The inside of the tube shall be reamed and burrs removed from the outside, holding the end of the tubing downward during these operations so chips or filings cannot fall into the tubing. Flaring shall be done with a flare block and yoke type screw feed flaring tool. After removing the tubing from the block, both surfaces of the flare shall be inspected for splits, cracks, or other imperfections; and if there are any imperfections, the imperfect flare shall not be used. In assembling the fittings, all contacting surfaces shall be thoroughly clean. Tubing shall not be sprung into place, and connections shall seat freely before sleeve nuts are tightened.

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

#### 151800 PLASTIC PIPE, TUBING, AND FITTINGS

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

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

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

Fittings shall be of the same material as the pipe and of equal or greater pressure rating, except that drainage waste and vent (DWV) fittings need not be pressure rated; and all fittings shall conform to the appropriate ASTM Specification. In general, fittings for rigid pipe

shall be socket type for solvent or fusion welding, and fittings for nonrigid pipe shall be insert or flare fittings as specified or acceptable to the Engineer.

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

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

#### 152100 PIPING SPECIALTIES

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

#### 152110 FLEXIBLE PIPE COUPLINGS

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

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

For cast-iron pipes, flexible couplings shall be Dresser; Smith-Blair; Baker; or equal.

For steel pipes, flexible couplings shall be Dresser Style 38; Smith-Blair 411; or equal, except where other Styles are required for special conditions. Where indicated on the Plans, flexible couplings shall be suitable for connecting pipes which have different outside diameters.

Flanged coupling adapters shall have not less than 2 anchor studs each.

Where flexible couplings are installed underground, Type 316 stainless steel bolts shall be used. The entire coupling shall be given a 20-mil coat of T.C. Mastic as manufactured by the Tape Coat Company, Inc.; Bitumastic No. 50 as manufactured by Koppers Company, Inc.; or equal.

Grooved-end couplings, to be used where indicated on the Plans, shall be as manufactured by Victaulic Company of America, Gustin-Bacon Group, or equal. Victaulic couplings for cast-iron pipe shall be Style 31. Couplings for steel pipe shall be Style 77. Gustin-Bacon Group couplings shall be as recommended by the manufacturer for the type of pipe. Adapter bands shall be welded to the ends of the steel pipe as necessary to permit proper installation of couplings.

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

#### 152130 EXPANSION AND VIBRATION CONTROL

Piping shall be installed in such a manner that equipment vibration will not be transmitted through the piping system and normal expansion and contraction with temperature changes will not induce damaging stresses in the piping or connected equipment. Where anticipated expansion is greater than can be absorbed by the normal piping configuration, provision shall be made as indicated on the Plans by loops, bends, and expansion joints to absorb the excess.

Care shall be taken in packing, shipping, and installing expansion joints to prevent damage to joint bellows or sliding surfaces. Care shall also be taken against damaging joints during pressure test. Expansion joints shall be locked against movement in any direction until the pressure test is completed.

Any visible damage to an expansion joint, whatsoever, shall be sufficient cause for the Engineer to reject said joint. A rejected joint shall be replaced with a like joint in a new and undamaged condition at no extra cost to the Owner.

#### 152134 RUBBER EXPANSION JOINTS

Rubber expansion joints shall be installed where shown on the Plans and as specified herein. Expansion joints shall be made of neoprene rubber and complete with control units and galvanized steel split retaining rings. Expansion joints shall be suitable for a working pressure of 125 psi. Expansion joints in pump suction piping and where required shall be suitable for a working pressure of 90 psi and 30 inches Hg vacuum. The rubber material shall be reinforced with imbedded steel rings and a strong synthetic fabric. Expansion joints shall have flanged ends with drilling to match that of the piping.

Expansion joints for blowers shall be rated at not less than 40 psi pressure and 15 inches Hg vacuum and shall be made of butyl type rubber formulated for service to 250 degrees F.

Expansion joints shall be Mercer Rubber Company, Style 500 or 700; Red Valve Company Inc., Type J-1; equivalent U. S. Rubber Company or Belmont; or equal.

#### 152617 DRAINAGE

Floor drainage system shall be furnished and installed as indicated on the Plans. Floor drain piping shall be extra-heavy cast-iron soil pipe with extra-heavy cast-iron soil pipe fittings.

#### 152618 EQUIPMENT AND FLOOR DRAINS

Equipment drains shall be Zurn Z-317-1, Josam 300-E2 combination drip drain, less clamping collar, or equal, with adjustable strainer head, floor level grate, and 6-inch diameter funnel extension and shall have inside caulking outlet and nickel bronze top. All other floor drains shall be Zurn Z-215, Josam 30000A universal floor drain with adjustable strainer, less clamping collar, or equal, and shall have inside caulking outlet and nickel bronze Type A strainer. Sizes of equipment drains and of floor drains shall be as indicated on the Plans. Strainers with 3-inch drains shall be 6-inch diameter, and strainers with 4-inch drains shall be 8-inch diameter.

#### 153000 VALVES

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

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

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

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

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

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

Bolts shall conform to ANSI B 16.1 except that underground, in concrete valve boxes, or in water may be cast-iron bolts and nuts, and all bolts and nuts under these conditions shall be painted with an asphaltic coating as specified in AWWA C 104, of at least 10 mils thickness. Cast-iron bolts and nuts shall be made of material having at least 50,000 psi tensile strength. The cast-iron bolts used with mechanical joints will be acceptable.

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

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

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

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

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

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

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

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

Where proper operation and utilization of equipment and facilities requires installation of valves not indicated or specified, the Contractor shall provide and install, upon acceptance by the Engineer, valves similar and comparable to valves specified for similar and comparable duty in other parts of the project, without additional cost to the Owner.

#### 153010 INSTALLATION OF VALVES

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

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

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

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

#### 153300 ECCENTRIC PLUG VALVES

Plug valves, unless otherwise specified or indicated on the Plans, shall be nonlubricated eccentric plug valves. Valves shall be equipped with a lever operator for valves of 4-inch size and smaller and with a worm gear operator for valves of 6-inch size and larger. Each valve shall be furnished with an operating wrench or worm gear operator.

Eccentric plug valves shall be semi-steel, (ASTM 126, Class B) eccentric type with neoprene or Buna N faced plug. The body seats in all valves of 3-inch size and larger shall have an overlay of not less than 90 percent nickel on all surfaces contacting the plug face. The stem bearing and bottom bearing shall be of stainless steel material. All internal parts except the body and plug shall be 300 Series stainless steel, Monel, or nickel.

Eccentric plug valves shall be designed and constructed for 150 psig working pressure. Eccentric plug valves shall be Dezurik, Homestead "Ballcentric", Dresser X-Centric, or equal.

Eccentric plug valves shall have ends as required by the piping details as indicated on the Plans. Plug valves in screwed pipelines may be screwed or flanged at the Contractor's option. The resilient face of the plug shall be of material which will operate satisfactorily at a temperature of 185 degrees F continuous and 215 degrees F intermittent for all valves except that valves in compressed air service shall be suitable for duty at 250 degrees F continuous. Valves shall be clearly marked to indicate their open and close positions.

#### 153400 CHECK VALVES

Except as otherwise specified, shown on the Plans, or approved by the Engineer, check valves shall be as follows: Check valves shall be for 125 pound or better service and suitable for operation in either horizontal or vertical position.

#### 153410 SWING CHECK VALVES

Swing check valves shall be of sizes indicated on the Plans and of a pressure rating as specified below. All check valves shall be designed for operation in either horizontal or vertical position.

Check valves 2-1/2 inches in size and smaller shall be 200 pound, Y-pattern, bronze, regrinding, swing check valves with screwed ends, Crane No. 36; Kennedy Figure No. 444; or equal, except check valves in welded steel pipes shall be 150 pound flanged Crane No. 38, Lunkenheimer No. 596; or equal.

Check valves 3 inches in size and larger shall be iron body, bronze-mounted, flanged-end, swing check valves, special Mueller A-2600 as manufactured by Mueller Company; H341 and H342 Ludlow-Rensselaer as manufactured by Patterson-Ludlow Division of Banner Industries Inc. with no parts made of brass or bronze containing over 6 percent zinc and no aluminum, and rated at 175 pounds per square inch, or equal. Hinge pins shall be stainless steel. Valves shall be equipped with outside lever and weight. The lever and weight shall be so constructed and so positioned that it can operate without interference by any piping, supports, or equipment.

#### 153700. HOSE VALVES

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

### 153710 PLAIN HOSE VALVES

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

### 154500 VALVE AND GATE OPERATORS

All valve operators other than T-wrenches or keys, and portable operators intended for operating more than one valve, or type of valve, shall be furnished by the valve or gate manufacturer as an integral part of the valve or gate. All similar operators shall be of one manufacturer. All gates and hand operating lifts shall be of the same manufacturer. All hydraulic gate lifts shall be of the same manufacturer and shall be furnished with shop drawings through the manufacturer of the gates as completely integrated units.

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

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

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

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

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

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

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

Buried operator housings for buried valves shall be oil and watertight, shall be specifically designed for buried service, and shall be factory packed with a suitable grease. The space between the operator housing and the valve body shall be completely enclosed such that no moving parts are exposed to the soil. Operators for buried valves shall be furnished with a 2-inch square AWWA operating nut.

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

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

Gate operators shall be as listed in the GATE SCHEDULE on the Plans.

#### 154530 GEARED VALVE OPERATORS

All manually operated butterfly valves larger than 6 inches on liquid service or 10 inches on gas or air and all plug valves 6 inches and larger shall be provided with geared operators. These operators shall be mounted on the valves at the factory. Valves mounted 6 feet or less above the floor shall have handwheel operators. Valves mounted more than 6 feet to center line above the floor shall have chain wheel operators. Operator shall have cut gears, either spur or worm, and shall be sized to operate the valve at the most adverse design condition with a pull at the handwheel or chain wheel rim of not more than 40 pounds.

#### 154600 PIPE HANGERS AND SUPPORTS

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

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

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

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

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

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

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

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

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

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

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

#### 154610 ANCHOR BOLTS AND INSERTS

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

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

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

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

Channel inserts shall be installed in all tunnels below grade even under buildings at not more than five feet on centers. Channel inserts shall be installed in tunnel ceilings where indicated on the Plans at not more than five feet on centers. Both wall and ceiling inserts shall be placed so that they are in line in tunnels ten feet and greater in width. In tunnels less than ten feet in width, the inserts shall be staggered at the midpoint spacing of the opposite wall. Channel inserts shall extend to within three inches of top of tunnel walls. Vertical channel supports installed opposite inserts shall extend to same height as inserts.

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

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

#### 154900 PAYMENT

Payment for work under this section, contained entirely within the lift station compound, will be made at the lump sum bid for Item 1500-1, Piping, Valves, Gates, and Specialties.

Payment for force main outside of lift station compound will be made per Section 615.

DIVISION 16

ELECTRICAL

160100 GENERAL

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

160101 GENERAL PROVISIONS

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

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

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

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

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

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

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

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

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

All electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 50 degrees C, and specifically rated for an altitude of 1,200 feet.

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

#### 160103 REGULATIONS AND CODES

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

#### 160104 SERVICE

The Contractor shall provide and install conduit wire and electrical service metering equipment in accordance with APS's requirements and as indicated on the Plans for 480 volts, 3 phase electrical supply.

#### 160105 TEMPORARY POWER

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

#### 160106 CUTTING AND REPAIRING

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

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

#### 160107 CORROSION PROTECTION

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

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

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

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

#### 160108 COORDINATION OF THE ELECTRICAL SYSTEM

The Contractor shall verify all actual equipment and motor full-load and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full-load and rated voltage.

The motor running overcurrent protection devices shall be rated or selected to trip at no more than 125 percent of the motor full-load current rating for motors marked to have a temperature rise not over 40 degrees C or motors marked with a service factor not less than 1.15 and at no more than 115 percent for all other types of motors. The motor controller size shall be coordinated to the current rating and horsepower size of the installed motor.

The motor-branch-circuit overcurrent protection device shall trip open in 30 seconds or less on locked-rotor current of the motor. This device shall also protect the motor-branch-circuit conductors and the motor control apparatus against overcurrent due to short-circuits or grounds. The motor control circuits shall have overcurrent protection of the type indicated on the Plans.

#### 160108.10 COORDINATION

A coordination study shall be made and curves submitted for review and acceptance by the Engineer. The study shall include all devices from the utility service to and including the secondary devices of medium voltage transformers.

#### 160109 TEST

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

#### 160110 CONFORMS TO RECORD DOCUMENTS DRAWINGS

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

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

#### 160111 SINGLE LINE DIAGRAMS

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

#### 160112 CIRCUIT IDENTIFICATION

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

In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, and termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seaton, or equal.

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

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

#### 160113 NAMEPLATES

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

#### 160114 AUTOMATIC EQUIPMENT WARNING SIGNS

Permanent warning signs shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.

Warning signs shall be 7 inches high by 10 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION  
THIS EQUIPMENT STARTS  
AUTOMATICALLY  
BY REMOTE CONTROL

#### 160115 HIGH VOLTAGE WARNING SIGNS

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

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

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

WARNING  
HIGH VOLTAGE  
KEEP OUT

#### 160116 CONDUCTOR FASTENERS

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

#### 160200 GENERAL MATERIALS AND METHODS

##### 160201 GENERAL

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

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

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

##### 160202 RACEWAYS

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

##### 160202.10 CONDUIT

##### 160202.11 GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

#### 160202.12 RIGID STEEL

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

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

#### 160202.16 RIGID NONMETALLIC - PVC

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

#### 160202.30 METAL PULL BOXES

#### 160202.31 GENERAL

Furnish and install pull boxes as indicated on the Plans and specified herein.

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

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

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

#### 160202.32 CONSTRUCTION

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

#### 160202.35 SIZING

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

#### 160203 CONDUCTORS

##### 160203.01 GENERAL

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

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

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

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

#### 160203.02 PULLING LUBRICANT

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

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

#### 160203.12 TERMINATIONS AND SPLICES (MEDIUM VOLTAGE)

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

#### 160203.20 600 VOLT CLASS CABLE

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

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

#### 160203.21 TERMINATIONS AND SPLICES (600 VOLT AND LESS)

Terminations shall be terminal board type with set-screw pressure connectors. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation. Conductors, including grounding conductors, of different sizes shall be spliced and then soldered or welded. Splices in wet locations and all splices below grade shall be waterproof heat shrink type as manufactured by Elastimold, Thomas-Betts, or equal.

#### 160203.30 INSTRUMENTATION CLASS CABLE

Instrument cable shall have the number of twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum.

The jacket shall be flame retardant Flamenal or Okoseal, 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.

The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with Okoseal or Vulkene, 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.

Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

Instrumentation cables shall be installed in separate raceways. This includes through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards.

The instrumentation cable shall be Type TC as manufactured by General Electric, Okonite, or equal.

#### 160204.11 TELEPHONE PANEL GROUND

An individual ground system shall be installed at the telephone panel(s).

#### 160205 OUTLET, SWITCH, PULL AND JUNCTION BOXES

##### 160205.01 GENERAL

Unless otherwise specified or indicated on the Plans, device boxes, condulets and junction boxes shall be heavy-duty cast and shall be compatible with the location and conduit system being used, rigid steel or rigid copper free aluminum and shall be as manufactured by Crouse-Hinds, Appleton, or equal, with stainless steel cover screws and with cover gaskets. Device boxes shall be FD type.

##### 160205.10 FASTENERS

Fasteners used with wiring devices shall be aluminum or stainless steel and all screws, nuts, bolts, etc. shall be stainless steel.

#### 160206 LIGHTING SWITCHES

##### 160206.01 GENERAL

Snap switches shall have the number of poles as indicated on the Plans, shall be specification grade, rated at 20 ampere, and shall be as manufactured by Hubbell, General Electric, or equal. Special switches, covers, etc. shall be as specified herein or indicated on the Plans.

##### 160206.10 INDOOR

Stainless steel cover plates shall be utilized.

160206.20 OUTDOOR AND CORROSION RESISTANT

Enclosures shall be weatherproof.

160207 RECEPTACLES

160207.01 GENERAL

Duplex receptacles shall be 2-pole, 3-wire grounded, 120 volts, industrial, rated at 20 amperes, and shall be as manufactured by Hubbell, General Electric, or equal. Special receptacles, covers, etc. shall be as specified herein or as indicated on the Plans.

160207.10 INDOOR

Stainless steel cover plates shall be utilized.

160207.20 OUTDOOR AND CORROSION RESISTANT

Enclosures shall be weatherproof with yellow "fiberglass" lift cover plates or accepted equal.

160207.30 GROUND FAULT INTERRUPTER RECEPTACLES (GFI)

GFI outlets shall be rated at 20 amperes at 125 volts AC as manufactured by Leviton, Bryant, or equal.

160207.50 240 VOLT RECEPTACLES

240 volt receptacles shall be of the ampere rating as indicated on the Plans, however, the minimum rating shall be 20 amperes at 250 volts AC and shall be as manufactured by Leviton, Bryant, or equal.

160208 PUSH-BUTTON STATIONS

160208.01 GENERAL

Push buttons, selector switches, and pilot lights shall be heavy-duty, oiltight Square D Company, General Electric Company, or equals. Control stations shall be in NEMA 4 enclosures for outdoor and NEMA 12 for indoor installations.

"Start-Lockout-Stop" push-button stations shall be installed adjacent to every motor unless specifically indicated otherwise.

160209 TRANSFORMERS - DRY TYPE

160209.10 DISTRIBUTION TRANSFORMERS - LOW VOLTAGE LIGHTING AND POWER

Transformers shall be of the premium high efficiency quiet type and shall be installed where indicated on the Plans. The primary winding of the transformers shall have two 2-1/2 percent taps above and below normal.

The transformers shall have a BIL of 10 kv with a temperature class of 185 degrees C for transformers up to 25 kva and a temperature class of 220 degrees C for transformers rated at 30 kva and larger.

The sound level shall not exceed 44 dba measured at 5 feet from the transformer after installation. Core and coil assemblies 30 kva and larger shall be mounted on rubber vibration isolators designed specifically to reduce 120 HZ sound and multiple harmonics.

Transformer standards shall be submitted to the Engineer prior to purchase and installation.

Transformers shall be of the types manufactured by General Electric Company, Westinghouse Corp., or equal.

#### 160209.20 FERRO RESONANT ISOLATION TRANSFORMERS

Ferro resonant isolation transformers shall be provided for all solid state devices and elsewhere where indicated. Regulation shall be  $\pm 3$  percent for an input range of  $\pm 10$  percent. Common mode noise rejection shall be better than 120 db with transverse mode noise rejection better than 60 db. Voltage spike attenuation shall be better than 250:1.

Isolation transformers shall be as manufactured by Shape Magnetronics, Control Concepts, Inc., or equal.

#### 160210 RELAYS

##### 160210.10 CONTROL RELAYS

Control relays shall be General Electric, Westinghouse, Square D Company, or equal, industrial 600 volt, 10 amperes type with contact arrangement and operating coils of the proper voltage as required by the control circuit sequence. Each relay shall have a minimum of 4 reversible pole contacts. The coils shall be sealed by pressure molding.

##### 160210.11 INTRINSICALLY SAFE RELAYS

Intrinsically safe relays shall allow the use of any type of remote pilot device located in Class 1 hazardous areas by providing a pilot circuit incapable of releasing sufficient electrical energy to ignite gases and vapors classified in Groups A, B, C, and D.

The unit shall have an output relay with double pole, double throw contacts rated at least 16 amperes at 120 volts AC, resistive load, and 24 volts DC. They shall operate on the AC supply voltage indicated on the Plans.

They shall be Cutler-Hammer, BW Series, or equal.

## 160211 TIMERS

### 160211.01 GENERAL

Timers which require pins or other removable trip devices shall be provided with at least one pin or trip device for each possible time setting.

### 160211.10 RESET TIMERS AND REPEAT CYCLE TIMERS

Timers of this type shall be heavy-duty industrial timers as manufactured by Eagle, Paragon, or equal.

### 160211.20 TWENTY-FOUR HOUR TIMERS

Timers of this type shall be heavy-duty industrial timers as manufactured by Paragon, Tork, or equal.

### 160211.30 TIMING RELAYS

Timing relays shall be heavy-duty industrial 600 volt, 10 amperes as manufactured by Square D Company, Westinghouse, or equal.

## 160212 ENCLOSURES

### 160212.01. GENERAL

This specification includes enclosures to house electrical controls, instruments, terminal boards, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 4 for outdoor installations.

### 160212.10 CONSTRUCTION - STEEL

Enclosures shall be from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. They shall be as manufactured by Hoffman, Fischer & Porter, or equal.

A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.

### 160212.11 FINISH - STEEL

Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

## 160213 SWITCHBOARDS, SWITCHGEAR, PANELBOARDS

### 160213.10 CIRCUIT BREAKER SWITCHBOARD(S)

#### 160213.11 GENERAL

The switchboard(s) shall be single panel, frame, or assembly of panels, on which shall be mounted on the face or back, or both, circuit breakers and instrumentation as indicated.

#### 160213.12 ENCLOSURE

The switchboard shall be dead-front with front accessibility. Each section shall have individual removable top and bottom plates for installation and termination of raceways. All metal surfaces and structural parts shall be given a phosphatizing, or equal, treatment prior to painting. The switchboard(s) shall then be given a gun-metal gray undercoat, which is equal to zinc chromate. The exterior of the enclosure shall be furnished in a color selected by the Engineer.

#### 160213.13 BUSING

Bus shall be silver or tin plated copper with an ampacity rating as indicated and shall be braced to have a short circuit current rating of 42,000 RMS symmetrical amperes.

#### 160213.14 CIRCUIT BREAKERS

Circuit breakers shall be as specified elsewhere herein.

#### 160213.15 SWITCHBOARD(S)

The switchboard(s) shall be as manufactured by General Electric, Westinghouse, or equal.

#### 160218 TERMINAL BLOCKS

Terminal blocks shall be Square D Co., Buchanan, or equal. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.

#### 160219 DISCONNECT SWITCHES

Disconnect switches shall be heavy-duty safety switches with a quick-make, quick-break operating mechanism, full cover interlock and indicator handle. The disconnect switches shall be furnished with fuses of the size indicated on the Plans. One set of spare fuses shall be furnished for each fused disconnect switch.

Disconnect switches shall be as manufactured by Square D, Westinghouse, or equal.

## 161100 CIRCUIT BREAKERS - LOW VOLTAGE

### 161100.01 GENERAL

All circuit breaker frame and trip ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished and shall be modified where necessary to suit this equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. Where no indication of type is given on the Plans, the following shall govern:

Circuit breakers protecting motors rated 7.5 horsepower or less shall be motor circuit protectors, all other circuit breakers shall be molded case circuit breakers.

Circuit breakers shall be as manufactured by Westinghouse, General Electric, or equal.

### 161100.10 MOLDED-CASE CIRCUIT BREAKERS

Circuit breakers for mounting in motor control centers or for separate mounting shall be of the air-break type, quick-make and quick-break, 600 volt, with number of poles as indicated on the Plans. The minimum frame size shall be 100 amperes.

Each pole of these breakers shall provide inverse time delay and instantaneous circuit protection.

The breakers shall be operated by a handle and shall have a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close and trip simultaneously.

Breakers must be completely enclosed in a molded case. Noninterchangeable trip breakers shall have their covers sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of nonwelding silver alloy. Arc extinction must be accomplished by means of arc chutes.

The minimum interrupting ratings of the circuit breakers shall be at least equal to the available short circuit at the line terminals.

Circuit breakers shall conform to the applicable requirements of NEMA Standards Publication No. AB1.

Circuit breaker ratings, modifications, etc. shall be as indicated on the Plans.

Molded case circuit breakers shall be ambient compensating that provides inverse time delay overload and instantaneous short circuit protection by means of a thermal magnetic element. Compensation shall be accomplished by a secondary bimetal that will allow the breaker to carry rated current between 25 degrees C and 50 degrees C with tripping characteristics that are approximately the same throughout this temperature range.

On breakers with interchangeable, thermal, adjustable magnetic trip, the accessibility and position of the adjustment knob shall not be changed from those on the standard breaker.

#### 161100.20 MOTOR CIRCUIT PROTECTORS

Electrical circuits shall be protected by motor circuit protectors (MCP) as manufactured by Westinghouse Electric Corporation, General Electric, or equal.

The MCP shall be operated by a handle and shall have a quick-make, quick-break switching mechanism that is mechanically trip free from the handle so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.

MCP's must be completely enclosed in a molded case. MCP's shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of nonwelding silver alloy. Arc extinction must be accomplished by means of arc chutes.

Each pole of these MCP's shall provide instantaneous short circuit protection by means of a single adjustable magnetic only element. The single adjustment screw shall adjust all poles simultaneously.

Provision shall be furnished in the MCP for locking the maximum achievable trip setting to values less than maximum obtainable trip setting. Each adjustment shall have 8 main setting points and mid-setting points following a linear scale so that each point has a significant value within calibration tolerances.

MCP's shall be suitable for use with current limiters, having 100,000 ampere interrupting capacity and a built-in trip indicator, that are fully coordinated with the MCP so that the MCP will open all 3 phases if the limiter operates. Current limiters shall be so constructed that they can only be replaced by an identical or similar limiter having the same interrupting capacity.

The minimum interrupting ratings of the MCP shall be at least equal to the available short circuit at the line terminals.

MCP ratings, modifications, etc., shall be as indicated on the Plans.

#### 161100.40 MODULAR OVERLOAD RELAYS

Where called for on the Plans, modular overload relays shall be provided with the motor starters. The modular overload relays shall be 3-pole solid state devices set by one plug-in heater and shall protect all 3 phases of the motor in ambient temperatures ranging from -20 degrees to +70 degrees C.

The jam modules shall plug in the modular overload relays and shall provide for instantaneous trip of the overload relay should the current exceed a preset value at any time after the motor has accelerated. The modules shall be adjustable to any value between 150 percent and 400 percent of the motor full-load current.

The underload modules shall plug in the MOR and shall provide for overload relay trip whenever the current falls below a set value after the motor has accelerated. The modules shall be adjustable between 50 percent and 90 percent of the full load value of the motor full load current.

Each module shall provide individual trip indication and reset for each trip condition, visible without opening the motor control center compartment door. Each module shall provide an auxiliary contact for remote trip indication.

All solid state circuits shall be completely protected from damage arising from line transients and voltage spikes.

They shall be as manufactured by Westinghouse, Square D Co., or equal.

#### 161200 MOTOR CONTROL - LOW VOLTAGE

##### 161200.01 GENERAL

Starters Size 2 and larger shall have arc quenchers on all load breaking contacts. Starters shall be suitable for the horsepower ratings specified, except the Contractor shall verify the motor ratings and coordinate the starter and overload trip ratings with the actual horsepower ratings of the motors installed. Extended overload reset buttons shall be mounted so as to be accessible for operation without opening the door of the enclosure.

Magnetic contactors shall be factory adjusted and shall be chatter free. Magnetic contactors shall have bimetallic type overload relays in each line conductor as indicated on the Plans.

Starters shall be furnished complete with a 120-volt control transformer unless otherwise noted.

Where above normal ambient temperatures are anticipated, circuit breaker trip elements and starter overload trip elements shall be supplied to meet such conditions and shall be acceptable to the Engineer.

Control fuses shall be furnished where indicated in the schematics.

The magnetic contactors shall not be smaller than the size indicated on the Plans. Starters shall be sized to handle motors furnished even if motors should be larger than indicated on the Plans.

The minimum size starter shall be NEMA Size 1.

#### 161210.20 MAGNETIC STARTERS

##### 161210.21 FULL VOLTAGE

Across-the-line full voltage magnetic starters for up to 600V shall have electrical characteristics indicated on the Plans.

Magnetic starters shall have: NEMA 12 enclosures unless otherwise noted; positive, quick-make, quick-break mechanisms; padlockable enclosure doors; 3 overload relays  $\pm 15$  percent adjustment from nominal heater rating on the overload relay; cover mounted reset button; and at least 3 reversible contacts in addition to the hold-in contact.

Magnetic starters shall be built in accordance with the latest NEMA Standards and shall be manufactured by Westinghouse Electric Corporation, General Electric, or equal.

#### 163130. BALLASTS

Ballasts shall be ETL/CBM certified for the purpose intended with built-in thermal protector that disconnects the ballast permanently prior to actual ballast failure.

Ballasts shall be high efficiency, high power factor, constant wattage type and shall be fused.

Ballasts shall be Advance, Universal, or equal.

#### 164000 STANDBY ELECTRICAL GENERATOR(S)

##### 164000.10. NATURAL GAS

##### 164000.11. GENERAL

The installation of a standby electric generating system shall include a Caterpillar, Onan, or equal, rated for standby service at a minimum of 75 kw delivered at 0.8 power factor, 480 volt, 3 phase, 3 wire, 60 hertz, 40 degrees C ambient, 1,200-foot elevation, without exceeding NEMA MG-1 - temperature rise limits.

The system shall be a package of:

1. A natural gas engine driven electric plant to provide standby electric power.

2. Engine mounted control system.
3. An automatic load transfer switch for switching of the load and control to provide automatic starting and stopping of the engine generator system.
4. Mounted accessories as specified.
5. Fuel and exhaust systems as specified or indicated on the Plans.
6. A weather-protective housing.
7. All other equipment as required to provide a complete and operable system.

All materials, equipment, and parts comprising the units specified herein, shall be new and unused, of current manufacture and of the highest grade. Engines shall be of heavy-duty, long-life construction, and converted automotive-type engines shall not be acceptable.

The engine, generator and all major items of auxiliary equipment shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment. The unit shall be factory assembled and tested by the engine manufacturer and shipped to the jobsite by his authorized dealer having a parts and service facility in the area. The performance of the electric plant shall be certified by manufacturer as to the plant's full power rating, stability, and voltage and frequency regulation, and field load tested at site.

The entire unit shall be for outdoor installation, and shall be housed in a weather-protective noise-attenuating metal enclosure to suit the equipment furnished. The enclosure shall incorporate sufficient louvers to meet the cooling and combustion air requirements of the unit, shall have 2-inch thick insulated walls, and have generously-sized lockable access doors for the control panel and maintenance access. The radiator exhaust shall be fitted with a low-loss air turning vane to discharge cooling air and noise vertically upward.

The units offered under these Contract Documents shall be covered by the manufacturer's standard warranty or guarantee on new machines and shall be a minimum of two years.

Before the equipment is installed, a factory certified test log of the generator set showing a minimum of 3/4 hour testing with 1/2 hour at 100 percent rated load, continuously, shall be submitted to the Engineer. This generating system shall be full-load tested at site in the presence of the Engineer for a period of 8 hours, with supplier providing necessary resistive load banks. Any defects which become evident during this test shall be corrected by the bidder at his own expense.

On completion of the installation, start-up shall be performed by a factory-trained dealer service representative. Operating and maintenance instruction books shall be supplied upon delivery of the unit and procedures explained to operating personnel.

#### 164000.12. ENGINE

The engine shall be water cooled inline or Vee-type four stroke cycle, internal combustion, naturally aspirated, spark ignited, and designed to use 950 Btu/cf, 1 hour natural gas for fuel. The engine shall be equipped with lube oil and intake air filters; lube oil coolers, fuel pressure regulator, and gear driven water pump.

The engine generator governor shall maintain isochronous frequency regulation from no load to full rated load and shall be equal to Caterpillar 2301/EG3P electronic governor.

The unit shall be mounted on a structural steel subbase and shall be provided with suitable vibration isolators.

Safety shutoffs for high water temperature, low oil pressure, overspeed, and engine overcrank shall be provided. An engine-mounted radiator with blower type fan shall be sized to maintain safe operation at 115 degrees F maximum ambient temperature. The radiator shall be equipped for a duct adapter flange. Air flow restriction from the radiator shall not exceed 0.5 inch H<sub>2</sub>O.

The engine cooling system shall be filled with a solution of 50 percent ethylene glycol.

Provide a residential type silencer as manufactured by Kittel, Maxim, or equal, including stainless steel flexible exhaust fitting for remote mounting, properly sized and installed, according to the manufacturer's recommendation. Silencer shall be mounted so that its weight is not supported by the engine. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed the maximum limitations specified by the generator set manufacturer.

Exhaust piping shall have stainless steel automatic exhaust cap. Exposed exhaust surfaces, including silencer, shall be coated with not less than 6 mils of inorganic zinc after sandblasting to "white metal".

The fuel supply system shall be supplied and installed by the Contractor in accordance with appropriate local codes and regulations. The fuel supply line shall be fitted with a 2-way, 24 volt DC solenoid operated gas shutoff valve which, when de-energized, shall provide positive shutoff of the fuel supply. A plug valve manual shutoff shall be installed in the line upstream of the solenoid valve.

All gas pipe underground shall be protected against corrosion by a coat of bitumastic paint followed by two wraps of Tapecoat CT as manufactured by Tapecoat Company, Inc; Scotchrap as manufactured by the Minnesota Mining and Manufacturing Co.; or equal.

An engine-mounted fuel pressure gauge, shall be provided.

A 24-volt DC electric starting system with positive engagement drive shall be furnished.

Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide two auxiliary contacts for activating accessory items. Controls shall include a 30 second cranking cycle limit with lockout. (Three 10 second cranks or a single 30 second crank.)

A unit mounted thermal circulation type water heater shall be furnished to maintain engine jacket water to 90 degrees F in an ambient temperature of 30 degrees F. The heater shall be single phase, 60 hertz, 120 volts. Heater shall be Chromalox, General Electric, or equal.

A 24 volt lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for 1-1/2 minutes total cranking time without recharging and shall be rated no less than 220 amp-hours. A battery rack and necessary cables and clamps shall be provided.

A current limiting battery charger shall be furnished to automatically recharge the batteries. The charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, DC ammeter, DC voltmeter and fused AC input. Amperage output shall be no less than 10 amperes.

#### 164000.13 GENERATOR

The generator shall be a 4-pole or 6-pole revolving field type with static exciter and magnetic amplifier or SCR voltage regulator. No commutator or commutator brushes shall be allowed. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100 percent epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and/or abrasive deterioration. The stator shall be directly connected to the engine flywheel housing, and the rotor shall be driven through a semiflexible driving flange to insure permanent alignment. Voltage regulation shall be within plus or minus 2 percent of rated voltage, from no load to full-load. The instantaneous voltage dip shall be less than 15 percent of rated voltage when full load and rated power factor is applied to the generator. Recovery to stable operation shall occur within 5 seconds. Stable or steady-state operation is defined as operation with terminal voltage remaining constant within plus or minus one percent of rated voltage. A rheostat shall provide a minimum of plus or minus 5 percent voltage adjustment from rated value. Temperature rise at full-load determined by resistance shall be within rating as defined by NEMA MG-1.

The specified standby kw shall be for continuous electrical service during interruption of the normal utility source.

These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.

A generator mounted NEMA 1 type vibration isolated 14 gauge steel control panel shall be provided.

Panel shall contain, but not be limited to the following equipment:

- Voltmeter, 3-1/2 inch, 2 percent accuracy
- Ammeter, 3-1/2 inch, 2 percent accuracy
- Voltmeter/Ammeter phase selector switch
- Frequency meter, 3-1/2 inch, dial type
- Automatic starting controls
- Panel illumination lights and switch
- Voltage level adjustment rheostat
- Engine oil pressure gauge
- Engine water temperature gauge
- Dry contacts for remote alarms wired to terminal strips
- Fault indicators for low oil pressure, high water temperature, overspeed, and overcrank
- Four position function switch marked AUTO, MANUAL, OFF/RESET, and STOP
- Battery charge rate ammeter if not furnished on separate charger
- Running time meter

A generator mounted main line molded case circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

#### 164040 AUTOMATIC TRANSFER SWITCH

##### 164040.10. GENERAL

Automatic transfer switch(es) shall be furnished and installed, as indicated on the Plans, with full load current rating of 150 amps at 480 volts, 3 phase, 60 hertz. The switch(es) shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a nonventilated enclosure. Withstand current rating shall be 22,000 A RMS.

The transfer switch shall be double throw, actuated by a single electrical operator momentarily energized with a total transfer time not to exceed one-sixth second. The switches shall be capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.

The normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, or magnets, and shall be silver alloy protected by arcing contacts, with magnetic blowouts on each pole. Parallel main contacts are not acceptable.

The transfer switch(es) shall be equipped with a manual operator that is designed to prevent injury to personnel if the electrical operator should become energized during manual transfer.

The transfer switch(es), including all parts and supports, shall meet a seismic loading equal to their weights multiplied by a force factor,  $C_p$ , of 1.00. The directions of force, simultaneously and separately, shall be in any horizontal and vertical planes. The switches shall be capable of normal operation during and after seismic loading. Seismic loading shall not cause false operation. The force factor,  $C_p$ , shall be as defined in the Uniform Building Code.

#### 164040.20 ACCESSORIES

The transfer switch(es) shall be equipped with the following:

1. Nominal 1- to 3-second time delay to override momentary outages.
2. Field adjustable 2- to 25-minute time delay to retransfer to normal source with 5-minute unloaded running time of standby plant. A switch shall be provided to bypass this feature with transfer to normal source made manually. Time delay shall be nullified if standby power fails and normal power is available.
3. Differential protection on 3 phases. Dropout and pick-up.
4. Test switch.
5. Auxiliary contacts which close when normal source fails.
6. Auxiliary contacts which open when normal source fails.
7. Auxiliary contacts on main contacts, closed on normal.
8. Auxiliary contacts on main contacts, closed on emergency.
9. Voltage and frequency lockout relay.
10. Six indicating lights - each indicating power on phases of normal and/or standby power sources.

11. To avoid excessive inrush currents, an integrally mounted phase monitor shall prevent transfer or retransfer until the phase angle between the power sources is within ten electrical degrees within a frequency differential of two hertz. The monitor shall not require any control wiring to the generator. The monitor shall be bypassed if the load carrying source fails and the alternate power source is available. UPS system(s) are or will be a power source.

#### 164040.30 OPERATIONAL TESTING

A means shall be provided to automatically start and run the standby generating set for a set period of time for the purpose of testing or exercising the complete engine, generator, and load transfer control. After completion of the set period of time for testing and exercising, the standby source shall be automatically shut down. Such periods for testing or exercising shall be adjustable in multiples of 15 minutes per period with the period repeated on any combination of days over a cycle of 7 days before recycling. During the period of testing or exercising, standby power shall not automatically assume its load.

#### 164040.40 TESTING

When conducting temperature rise tests in accordance with UL-1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the switches to carry full rated current after completing the overload and endurance tests.

The transfer switch, complete with all accessories, shall be listed by UL under Standard UL-1008.

The manufacturer shall issue a certification of compliance with the Plans and Contract Documents which is signed and sealed by a Registered Professional Engineer.

On completion of the installation, start-up shall be performed by a factory-trained service representative in the presence of the operating personnel and the Engineer.

Prior to acceptance of the installation, the equipment shall be subjected to:

Load tests with all available motor load, but not to exceed generator's nameplate rating.

Any defects which become evident during this test shall be corrected by the Contractor at his own expense.

The transfer switches shall be as manufactured by Automatic Switch Company, R. G. Russell Company, or equal.

#### 167000.1. FLOAT SWITCH

Float switch shall be direct acting and consist of a 316 type stainless steel housing, mounting clamp, a flexible three-conductor cable with a synthetic rubber jacket and a mercury switch. The float housing shall be a sphere of at least 5-1/2 inches in diameter.

The mercury switch shall be embedded in a metal housing inside the float. The cable shall be No. 14 AWG with 105 strands per conductor, made specifically for underwater use and heavy flexing service.

The mercury switch shall be connected to two of the three conductors of the cable. The third conductor shall be an internal ground and shall be colored green. The switch shall have a 20 ampere rating at 115 volts AC. An additional synthetic rubber jacket shall act as a hinge between the float and where the cable is held by the stationary clamp. This clamp shall be stainless steel with an adapting fitting and two yokes for mounting on a vertical 1-inch pipe.

A liquid rise of 1-inch from the reset position shall operate the float switch, and reset shall occur when the liquid level drops to 1-inch. Operating temperature shall be 0 degrees F to +180 degrees F.

Weight and buoyancy shall be such that contaminants like a cake of grease will not result in the float switch changing operating level more than 1-inch.

A cast aluminum, NEMA 4 junction box shall be supplied for termination of the float cable(s), to allow conventional wiring and conduit to be run from the junction box to a control panel. It shall have terminal blocks for the required number of circuits and shall accept sealed fittings furnished with the float switch. The float switches and assembly shall be manufactured by Consolidated Model 9G, or equal.

#### 168000.1. AUTO DIALER

The Contractor shall provide and install an automatic dialing, remote monitoring unit as manufactured by RACO, Chatterbox Model CB-4, compatible with similar units previously provided to the City of Phoenix by RACO.

The unit shall be enclosed in a vandal proof NEMA 4X enclosure together with padlock and keys (3).

Emergency power batteries shall be provided for 24 hour duration. A local alarm relay output shall be provided. The unit shall accept four dry contact inputs to indicate alarm condition when these remote contacts are in the closed position. A custom extended vocabulary shall be provided. The auto dialer shall operate on 120 volts AC, 60 hertz and be complete with battery charger.

Anti-condensation heaters shall be provided, surge protection equipment shall be provided for phone, power and signal lines. The unit shall operate at a temperature of 20 degrees F to 130 degrees F, 0-95 percent humidity noncondensing. The unit shall operate over a standard telephone leased line. Programming shall be performed by the manufacturer to the City of Phoenix' requirements. Loss of power indication shall be provided.

169000. PAYMENT

Payment for standby generator will be made at the lump sum bid for Item 1600-1, Standby Generator.

Payment for control panel will be made at the lump sum bid for Item 1600-2, Control Panel.

Payment for switchboard will be made at the lump sum bid for Item 1600-3, Switchboard.

Payment for underpass lighting will be made at the lump sum bid for Item 1600-4, Underpass Lighting.

Payment for underground conduit and wire will be made at the lump sum bid for Item 1600-5, Underground Conduit and Wire.

Payment for incidental wiring, fittings and devices will be made at the lump sum bid for Item 1600-6, Incidental Wiring, Fittings, and Devices.

Payment for service conduit, wiring and pad for APS, and Bell Telephone conduit will be made at the lump sum bid for Item 1600-7.

## DIVISION 17

### INSTRUMENTATION

#### 170002.10 CIRCULAR CHART RECORDER

The circular chart recorder shall be capable of recording up to four points on a 10-inch chart. The chart recorder shall be fully programmable in order that the recorder can be configured to accept DC voltages, thermocouple, RTD inputs and, specifically, a 4-20 ma DC input signal from an associated magmeter. All necessary signal conversion equipment shall be provided. All nonlinear inputs shall be linearized and provision must be supplied for special linearizations. The chart speed must be programmable from 1-4096 hr/resolution. The ranges and span of the input signals must be programmable to give appropriate representation on the applied charts. In addition to the recording function, the recorder shall have provisions for individual 16-character tags and messages per channel. In addition to the chart recording, there shall be a vacuum-fluorescent display that will show the appropriate tag or description and the displayed process variable being measured. The recorder shall also have assignable alarms for each pen. There will also be red LED displays to show the status of the alarms. The recorder shall also have an RS232/RS422 data communications port.

The recorder shall have the capability of integrating and totalizing up to four variables such as in the case of flow measurements. These integrating counters shall be 9 digits displayed on the vacuum fluorescent display and shall be selectable as reset or nonreset type.

The recorder shall be suitable for wall mounting and shall be in a NEMA 4X enclosure.

The recorder shall be a Chessell Model 390, Bristol-Babcock, or equal.

All displays shall be in engineering units. The recorder shall have an accuracy of  $\pm 0.5$  percent of span, a dead band of  $\pm 0.2$  percent of span, and a repeatability of  $\pm 0.2$  percent of span. The recorder shall be powered by 120 volts AC.

One year's supply of charts and ink shall be provided. Electrically isolated inputs and electrical zero and span adjustments shall be provided with no mechanical adjustments. Damping and pen speed response shall be adjustable.

#### 170012.10. MAGNETIC FLOW SENSORS

Magnetic flow sensors shall be furnished and installed as required, complete with associated instrumentation, interfaces, cabling, and, as a minimum, shall consist of the following:

#### 170012.11. MAGNETIC FLOWMETERS

Magnetic flowmeters shall be high impedance pulsed DC type constructed with polyurethane liners and 316 stainless steel electrodes suitable for the intended use and capable of withstanding a partial vacuum of 10 feet negative head. No ultrasonic cleaning equipment shall generally be required. Should the manufacturer require ultrasonic cleaning it shall be of the continuous cleaning type integral with the magmeter.

Unless otherwise indicated on Plans, the power supply to the meters shall be 120 volts, 60 hertz. It shall be installed in accordance with DIVISION 16 of these Contract Documents and in conformity with the recommendations of the manufacturer of the meter.

The meters shall be splashproof and shall be able to withstand accidental submergence in water (30 feet). The meters shall be coated with a corrosion-proof epoxy paint.

The output of the meter shall be linear and directly proportional to the average velocity of the fluid flowing through the meter tube. Neither turbulence nor variation in velocity profile within the flowing fluid shall affect the accuracy of the transmitter in its ability to measure the average flow. The meter shall also not be affected by a concentric buildup of slime which has the same conductivity as the flowing fluid.

The unit shall be self-zeroing with no adjustment necessary or provided.

Each magnetic flowmeter shall be grounded to a 10 foot long by 5/8-inch diameter copper clad ground rod, or an individual concrete encased ground electrode, or an existing grounding electrode conductor.

Stainless steel grounding rings shall be provided to bond liquid to meter, if required by the manufacturer.

Meter sizes and calibrations shall be as shown on Plans and/or elsewhere in these Contract Documents.

The standard calibrated accuracy of the entire system, including read-out, shall not be less than  $\pm 0.5$  percent of maximum flow or 1 percent of rate for all metered velocities between 3 and 30 feet per second. The meter shall give no "ghost readings" under a condition of zero flow. The repeatability of the scale reading shall not be less than 0.5 percent of full scale reading and shall not be affected by fluctuations of line voltages of  $\pm 10$  percent or frequency of  $\pm 1$  percent.

A 4-20 ma DC signal, together with power supply, shall be provided.

A 1/2 percent rate accuracy for scaled pulse signal for high accuracy billing register metering shall be provided as required elsewhere in the Contract Documents.

The flowmeters shall be KROHNE; Fischer & Porter; or equal. The manufacturer shall have had a meter of the same design and similar size continuously metering like fluid for a period of time to the satisfaction of the Engineer.

#### 170012.12. SIGNAL CONVERTERS

The signal converter assemblies shall be mounted in NEMA 4X enclosures or NEMA 4 enclosures with corrosion-proof epoxy paint. They shall have a 4-20 ma DC and pulse output to be used to totalize, indicate, and control. All converters shall be mounted where they are easily accessible for repair and calibration. If it is required that the flowmeter be mounted in an area where accessibility may be difficult, the electronics portion should be remotely located for ease of service.

Where called for on the Plans, a local flow indicator shall be provided, scaled in engineering units.

Cable and conduit between flowmeters and signal converters shall be furnished and installed. The size and type of cable and conduit shall be in accordance with the meter manufacturer's recommendations.

The signal converters shall be the same manufacturer as the magmeter.

#### 170012.13. CALIBRATOR

One portable secondary calibrator shall be furnished for the magnetic flowmeters. The calibrator shall be a passive device designed to simulate the flow signal from the flowmeter. It shall have a multi-position switch and/or a fully adjustable vernier dial for different flow velocities. An electrical adaptor shall be provided for use with the calibrator, for use with low conductivity systems.

The calibrator shall be of the same make as the flowmeters and shall be specifically designed for the type of flowmeter furnished. It shall be the same manufacturer as the magmeter.

#### 179000. PAYMENT

Payment for circular chart recorder and signal converter will be made at the lump sum bid for Item 1700-1, Circular Chart Recorder.

Payment for magnetic flowmeter will be made at the lump sum bid for Item 1700-2, Magnetic Flowmeter.

No separate pay item shall be contained in the Proposal for magnetic flow sensors or calibrator. These items shall be included in the price bid for Magnetic Flowmeter.

## GENERAL

The term "or equal", when used in the description of any construction materials, shall be understood to mean "or approved equal", as determined by the Engineer.

The Flood Control District of Maricopa County reserves the right to adjust design grades or the location of the sewer lines and structures prior to construction, if it should become necessary in the opinion of the Engineer, without additional cost to the Flood Control District of Maricopa County.

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

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

No vehicular loads will be permitted on the bridges before the lapse of twenty-one (21) days from the date of the last pour of concrete for the bridge substructure, unless approval is obtained in writing from the Engineer.

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

## GUARANTEE

The Contractor shall guarantee the structures for one year against faulty materials, faulty workmanship, and failure to meet the specifications requirements. Said guarantee by the Contractor shall not apply to damage caused by earthquakes or other acts of God, land subsidence or faulty operations or any abuse of the structures by others.

WATER & SEWER LINE RELOCATION  
FROM CENTRAL AVENUE TO 7TH AVENUE

Pages 1 through 9 of these Construction Special Provisions apply to the plans prepared by John Carollo Engineers of the Seventh Street Bridge over the Arizona Canal Diversion Channel (Sheets 1 through 28 of 28) AND the plans prepared by Morrison-Knudsen Engineers for the Sewer Relocation-Central to 7th Street (sheets 1 through 8 of 8) AND the Morrison-Knudsen plans for the Water Relocation-Central Avenue, 1st St. and Butler (sheets 1 through 4 of 4).

Pages 10 through 114 of these Construction Special Provisions apply to the plans prepared by John Carollo Engineers for the Seventh Street Bridge over the Arizona Canal Diversion Channel (sheets 1 through 28 of 28).

Pages 115 through 119 of these Construction Special Provisions apply to the plans prepared by Morrison-Knudsen Engineers for the Sewer Relocation-Central to 7th Street (sheets 1 through 8 of 8) AND the Morrison-Knudsen plans for the Water Relocation-Central Avenue, 1st St. and Butler (sheets 1 through 4 of 4).

PROPOSED WORK:

Construction of approximately 2600 LF of 10" sanitary sewer and 172 LF of 8" sanitary sewer plus manholes and other related miscellaneous work. Also the installation of approximately 570 LF of 6" water main, fire hydrant, new services and its miscellaneous related work.

LOCATION OF WORK:

This project is located in Phoenix, Arizona at two locations.

- a. Crossing Central Avenue approximately 80 Ft. north of Ruth Avenue
- b. From the alley north of Orchid Lane along 1st Street through the intersections at 1st Street and Orchid and Butler Drive. From Butler Drive, southeasterly along Las Palmaritas to the alley approximately 250 Ft. west of 7th Street.

SECTION 201 - CLEARING AND GRUBBING:

This work consists of removal and disposal of all trees, stumps, asphaltic pavement, and structures within the limits of the roadways and easements, as designated on the plans. Materials shall be disposed of off-site at the Contractor's expense.

Except as noted on the plans, the Contractor shall note that trees on private property shall not be removed without prior approval of the property Owner, and the Contractor will be required to work around trees and protect them from damage during the course of his work.

No separate payment will be made for clearing and grubbing, and the costs thereof shall be included in the price bid for related items of work.

SECTION 336 - PAVEMENT MATCHING AND SURFACING REPLACEMENT:

The asphalt and ABC suppliers shall provide certificates of compliance and test results indicating conformance with MAG Standard Specifications. Pavement replacement will be paid for under bid items 336-1 and 336-2.

SECTION 340 - CONCRETE CURB, GUTTER, SIDEWALK, DRIVEWAYS & ALLEY ENTRANCES:

Work under this section will be paid for under bid items 340-6 through 340-9.

SECTION 350 - REMOVAL OF EXISTING IMPROVEMENTS:

Work under this section will be paid for under bid items 350-15 and 350-16.

SECTION 401 - TRAFFIC CONTROL:

Central Avenue shall be considered a major street. The Contractor shall maintain Central Avenue open to traffic (one lane in each direction) at all times.

All traffic and/or traffic control devices on this project shall be provided, maintained, and/or controlled as specified in the City of Phoenix Traffic Barricade Manual, latest revision.

Permission to restrict city streets, sidewalks, and alleys (street closure permits) shall be requested as specified in Section III of the Traffic Barricade Manual.

Unless otherwise provided for, all traffic on this project shall be regulated as specified in Section IV of the Traffic Barricade Manual.

Payment for Traffic Control will be paid for at the lump sum bid price for bid item 401-5.

SECTION 601 - TRENCH EXCAVATION, BACKFILLING, AND COMPACTION:  
601.2.1 GENERAL:

No extra compensation or additional time will be authorized for claims that soil conditions differ from those anticipated or those indicated by soils logs and/or reports. It is the Contractor's responsibility to make his own determination as to actual existing conditions.

SECTION 601.2.2 - TRENCH WIDTH:

If the Contractor elects to slope the trench walls in lieu of shoring, sheeting or other wall support measures, he shall be responsible for any and all problems encountered and costs incurred as a result of the increased trench width. Furthermore, no increases in contract time will be allowed as a result of sloping trench walls. Payment will be limited to MAG trench widths defined in Section 336.4.

SECTION 601.2.3 - TRENCH GRADE:

Subsection 601.2.3 Trench Grade, the second paragraph is modified to read:

For all pipe, the Contractor shall overexcavate the bottom of the trench by a minimum of 4 inches or 1/12 the O.D.

SECTION 601.2.5 - OVER EXCAVATION:

When the Engineer determines that over excavation and backfilling, below the normal foundation and bedding depth, are required as a result of unsuitable material, it will be considered extra work. Payment and construction time extension will be negotiated with the Contractor or as otherwise provided for in these contract documents. As a condition of the Contractor receiving payment, agreement on method of payment and construction time extension shall be reached prior to start of work unless otherwise authorized in writing by the Engineer.

SECTION 601.2.8 - GRADING AND STOCKPILING:

Excavated material shall not be considered as unsuitable due to an excessive moisture content or an inadequate moisture content for proper compaction. The Contractor shall take whatever measures are required, at his own expense, to add or remove moisture from material to be used as backfill in order that proper compaction can be obtained within the limits set in Subsection 601.4.

The Contractor may elect, at no cost to the Flood Control District to haul off and dispose of excessively wet or dry material and replace it with material conforming to the specifications for backfill.

In either event, the proper compaction shall be obtained.

There will be no additional payment or time extension allowed for this work.

SECTION 601.4.2 - BEDDING:

The first paragraph is modified to read:

For all pipe, the bedding material from the bottom of the trench to one foot over the top of the pipe shall be ABC or Select Material, Type "B", per Section 702 compacted to a minimum density of 95 percent when tested by AASHTO T-99 (Method "A") with rock correction and T-191.

All bedding shall be included in the unit price bid for the pipes.

SECTION 601.4.3 - BACKFILL:

Delete the fourth paragraph in its entirety, and substitute the following:

When mechanical compaction is to be used, the Contractor shall provide a test section demonstrating his proposed method and equipment to be used. Upon agreement with the Engineer as to the acceptability of the Contractor's proposed method and equipment, they shall not be changed without the prior approval of the Engineer. Mechanical compacted lifts in excess of one foot will not be allowed without the express written consent of the Engineer.

Backfill material shall be within the range of +2% to -4% of the optimum moisture content, prior to placing the material in the trench. The moisture content shall be uniform throughout the backfill material. Material not meeting these requirements may be required to be removed from the trench and moisture added or removed to correct the deficiencies prior to replacement, all at the Contractor's expense.

It shall be the Contractor's responsibility to blend excavated material, removing or adding moisture as may be necessary to meet the requirements of the specifications, all at the Contractor's expense.

Excavated material when used for backfill shall meet the requirements of the preceding paragraph.

The moisture content requirements contained herein are waived when granular material is used and jetting methods.

The Engineer may require all or any part of the trench to be load-tested for stability with contractor's equipment prior to placement of asphalt. Unstable areas as determined by the Engineer shall be corrected by the Contractor at his expense.

SUBMITTAL:

The Contractor shall submit his plan, methods, and procedures for protecting existing utilities prior to beginning construction. Approval of the plan does not limit the Contractor's responsibility for utility protection, and the Contractor shall implement all additional utility protection measures as determined to be necessary in the field.

SECTION 601.4.4 - COMPACTION DENSITIES:  
Manholes shall be considered structures.

SECTION 610 - WATER LINE CONSTRUCTION:  
The Construction of the water line and appurtenances shall conform to the applicable MAG Standard Specification and Details, and City of Phoenix Supplements thereto. Fire hydrants furnished by the Contractor shall conform to the requirements of Section 756.

No plastic water pipe shall be used on this project.

Water line construction will be paid for under bid items 610-6 through 610-25.

SECTION 615 - SEWER LINE CONSTRUCTION:  
Sanitary sewer line construction shall conform to Section 615 of the MAG Standard Specifications, the City of Phoenix Supplement, and the project plans. The Contractor shall maintain continuous flows through existing sewer lines until they are connected to the new sewer line under this project.

The Contractor shall furnish and install 8 and 10 inch vitrified clay sewer pipe according to MAG Sections and COP Standard Details.

Sewer line construction will be paid for under bid items 615-5 through 615-9.

SECTION 615.3 - PIPE BULKHEADS:  
The Contractor shall, at the close of each day's work and at other such times when pipe is not being laid, CLOSE the end of the pipe with a temporary stopper. The cost for temporary stoppers shall be incidental to the project.

SECTION 625 - MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS:  
Sanitary sewer manholes shall conform in their entirety to Section 625 of the MAG Standard Specifications and MAG Details 420 and 424 except as modified by COP Detail P-1430 and MAG Detail 426 as modified by the contract drawings.

Manhole construction will be paid for under bid items 625-4 through 625-6.



SUPPLEMENT "A"

# Recommended Practice for Abandonment or Removal of Used Underground Service Station Tanks

API BULLETIN 1604  
FIRST EDITION, MARCH 1981

American Petroleum Institute  
1220 L Street, Northwest  
Washington, D.C. 20005



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## FOREWORD

This recommended practice provides a guide in the form of operating procedures which may be used for the abandonment, removal, storage, placed temporarily out of service, and sale of used underground tanks which have contained gasoline or other flammable liquids. Whereas this guide refers to service station features, the principles outlined may be applied to tanks used in other functions. Listed below are other available references which will provide additional guidance.

NFPA No. 30: Flammable and Combustible Liquids Code

NFPA No. 327: Standard Procedure for Cleaning or Safeguarding Small Tanks and Containers

NFPA No. 329: Underground Leakage of Flammable and Combustible Liquids

(Published by the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210)

API Publication 2013, Cleaning Mobile Tanks in Flammable or Combustible Liquid Service

API Publication 2015, Cleaning Petroleum Storage Tanks

API Publication 2015A, A Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning (Supplement to API RP 2015)

Storage tanks which have stored flammable liquids should be handled with extreme care when abandoned, moved, or stored. This is particularly true of underground tanks at service stations which are most frequently used for the storage of motor fuel and for the storage of other flammable or combustible liquids such as crankcase drainings (which may contain some gasoline).

## CONTENTS

|                                    | PAGE |
|------------------------------------|------|
| Temporarily Out of Service .....   | 1    |
| Abandonment in Place .....         | 1    |
| Removal of Underground Tanks ..... | 2    |
| Storage of Used Tanks .....        | 3    |
| Sale or Reuse .....                | 3    |
| Junking .....                      | 4    |

# Recommended Practice for Abandonment or Removal of Used Underground Service Station Tanks

## 1—TEMPORARILY OUT OF SERVICE

**1.1** Underground tanks are considered "temporarily out of service" if they are idle but will be returned to service, are awaiting abandonment, in place, or are awaiting removal.

**1.2** Tanks temporarily out of service will be considered safe for the "temporary" period if they are treated as provided in 1.2.1 through 1.2.3.

**1.2.1** Remove all flammable liquid with the exception of a sufficient quantity (approximately 4 inches) to assure a saturated vapor space.

**1.2.2** Cap the fill pipe and gauge pipe and secure the tank against tampering. Cap the product lines at the service station island or elsewhere if the pumps are removed, or leave the pumps connected and locked. Turn off electric power to the pumps.

**1.2.3** Leave the vent line open.

**NOTE:** This procedure is not intended to apply to tanks containing special fuels or to large installations, such as at airports where specific attention to the problems of corrosion, contamination, and preservation of quality is required.

## 2—ABANDONMENT IN PLACE

**2.1** This guide provides a safe method for the abandonment of underground tanks in place to avoid the cost of removal. Abandonment in place is usually less costly than removal; however, it is not necessarily so when the proper procedures for abandoning tanks in place are carefully followed.

**2.2** A determination of whether to abandon a tank in place or to remove it will depend upon the location, labor, materials, local regulations, availability of equipment, and the cost of each of these elements. Additional considerations include the length of service the equipment has provided and its reuse or salvage value. The federal Solid Waste Disposal Act places restrictions on disposal of hazardous materials such as tanks containing lead contaminants.

**2.3** Tanks may be effectively and safely abandoned underground by following the steps in 2.3.1 through 2.3.8.

**2.3.1** Drain and flush the piping into the tank.

**2.3.2** Remove all flammable liquid which can be pumped out. It may be necessary to use a hand pump to remove the bottom few inches of product.

**2.3.3** Dig down to the top of the tank.

**2.3.4** Remove the fill (drop) tube. Disconnect the fill, gauge, and product lines. Cap or plug open ends of lines

which are not to be used further. The vent line should remain connected until the tank is filled as outlined below.

**2.3.5** Fill the tank to overflowing with water to purge off all product. As the level of the liquid rises, any remaining product will float on top of the water. When the floating product nears the fill opening, suspend filling, remove the floating product, and place it in a suitable container for proper disposal.

In the process of water-filling the tank, flammable vapors will be expelled through both the vent and fill openings, but primarily at the fill opening. Purged product may also flow out of the fill opening as tank overfilling is continued. The entire area of operation should therefore be considered hazardous and all necessary precautions should be taken to prevent ignition.

In some locations water may not be available or its use may be impractical because of low atmospheric temperatures or for other reasons. In such instances the vapors in the tank may be expelled by adding solid carbon dioxide or another inert gas as explained in 3.1.6.

**2.3.6** After water has overflowed the tank, cut one or more large holes in the tank top. This can be accomplished with several blows from a back hoe. Pump out the water and dispose of it in accordance with local regulations. Drive several holes in the tank bottom with a ¼ or 1 inch rod.

**2.3.7** Proceed to introduce a suitable, solid, inert material through the hole in the top of the tank.

**2.3.7.1 Sand Fill.** Sand will flow readily and is generally available. Any kind of sand is suitable if it is free of rocks, which might limit leveling-out in the tank. The sand may be introduced dry as long as it flows in freely. When the cone nears the tank top, the sand can be washed into the tank with a nominal amount of water and puddled to cause it to flow to the ends. The use of large amounts of water should be avoided since the tank might be filled with water before it is filled with sand.

**2.3.7.2 Sand and Earth Fill.** Almost complete filling can be achieved by using a combination of sand and earth as follows: (1) fill the tank with sand to approximately 80 percent of calculated capacity; (2) mix soil and water to make a free-flowing mud; and (3) pour the mixture into the

tank opening and puddle until the tank is full and overflows the fill opening.

**2.3.8** Disconnect and cap the vent line.

**2.4** When underground tanks are abandoned in place, the owner of the tank should keep a permanent record of the tank location, the date of abandonment, and the method of conditioning the tank for abandonment.

**2.5** It is a good business practice to inform property owners of the presence of abandoned underground tanks when properties are sold or at the termination of property leases. It may be desirable to obtain an acknowledgement or a release from the property owner.

### 3—REMOVAL OF UNDERGROUND TANKS

**3.1** The safe removal of underground tanks can be accomplished by taking the steps described in 3.1.1 through 3.1.8.

**3.1.1** Drain and flush the piping into the tank.

**3.1.2** Remove all flammable liquid from the tank which can be pumped out. It may be necessary to use a hand pump to remove the bottom few inches of product.

**3.1.3** Dig down to the top of the tank.

**3.1.4** Remove the fill (drop) tube. Disconnect the fill, gauge, product, and vent lines. Cap or plug open ends of lines which are not to be used further.

**3.1.5** Temporarily plug all tank openings, complete the excavation, and remove the tank, placing it in a secure location. Block the tank to prevent movement. Before undertaking degassing measures, it is normally necessary to remove the tank from the ground since product which may have previously leaked into the ground could reenter the tank. Extreme caution should be used during this procedure.

**3.1.6** Remove flammable vapors. The tank should be conditioned by one of the methods described in 3.1.6.1 through 3.1.6.3, or as required by local codes, to ensure that no flammable vapors remain.

**3.1.6.1** If water is available and there is a suitable means for disposal, the tank may be filled with water to expel vapors. While the tank is being filled with water, flammable vapors will flow out of the tank and may surround the area. Purged product may flow out of the tank if it overflows. Hence, observe all normal safety and pollution precautions regarding flammable liquids and vapors. When the tank is to be removed from the premises, the

contaminated water should be removed and disposed of in accordance with local regulations.

**3.1.6.2** If the method described in 3.1.6.1 is not practicable, the vapors in the tank may be made inert by adding solid carbon dioxide (dry ice) in the amount of 1.5 pounds per 100 gallons of tank capacity. The dry ice should be crushed and distributed evenly over the greatest possible area to secure rapid evaporation. Avoid skin contact with dry ice because it may produce burns. As the dry ice vaporizes, flammable vapors will flow out of the tank and may surround the area. Hence, observe all normal safety precautions regarding flammable vapors. Make sure that all of the dry ice has vaporized.

**3.1.6.3** An alternate method is to ventilate the tank with air, using a small gas exhauster operated with compressed air (from the service station or from a portable compressor) or by other suitable means. The flow of air in through an opening near one end of the tank and the discharge of the vapor-air mixture out of an opening near the opposite end will quickly remove the vapor. The vapor concentration in the tank can be checked with a combustible gas indicator to determine when the tank is gas-free. While the tank is being ventilated, flammable vapor may flow into the surrounding atmosphere. Ignition sources should be eliminated from the immediate vicinity.

**3.1.7** After the tank has been freed of vapors and before the tank is moved from the site, plug or cap all holes. Use screwed (boiler) plugs to plug any corrosion leak holes. One plug should have a 1/8-inch vent hole to prevent the tank from being subjected to an excessive pressure differential caused by extreme temperature changes.

**3.1.8** Finally, the tank should be secured on a truck for

transportation to the disposal site. The tank should be secured so that the 1/8-inch vent hole is located at the uppermost point on the tank.

3.2 If a tank remains at the site overnight, or longer.

additional vapor may be released from liquid held in the scale or sediment in the tank. Consequently, tanks should be removed from the premises as promptly as possible after these procedures have been completed.

#### 4—STORAGE OF USED TANKS

4.1 Even though used tanks that have contained flammable liquids have been gas-freed at one time, they cannot be guaranteed to remain gas-free. Hydrocarbons are retained in crevices and under scale and are released over time. It is important, therefore, that tanks always be handled with due precautions in recognition of this condition.

4.2 The procedure outlined in 4.2.1 through 4.2.6 is recommended for storing tanks.

4.2.1 Used tanks should be stored in areas where they can be safeguarded, usually on the locked premises of a tank user familiar with the hazards or at another location where the general public will not have access. A fenced yard, apart from other facilities, is desirable.

4.2.2 If facilities are available for gas-freing by water-flooding, gas inerting, or mechanical ventilation, it is desirable to gas-free tanks before they are stored. Observe all normal safety and pollution precautions regarding flammable liquids and vapors.

Tanks will become gas-free by natural ventilation if they are stored off the ground with all openings down and open for a protracted period. During this period of natural breathing, caused by temperature change, the vapors may

be within their flammable limits. To assure safe operations, the condition of the tanks should be indicated by a label or sign, and unauthorized personnel should be prohibited from the area during this period.

4.2.3 During storage or preparation for storage, scale or sludge may be released from tanks which have contained leaded gasoline. Such scale or sludge must be handled with extreme caution and must be disposed of consistent with the requirements of the Solid Waste Disposal Act and local and state requirements.

4.2.4 Gas-free tanks may be safely stored with unplugged openings, but plugging of all openings is recommended to keep tank interiors clean.

4.2.5 In any of the foregoing cases where all tank openings are to be tightly plugged, screwed plugs should be used. In addition, one plug should have a 1/8-inch vent hole to prevent the tank from being subjected to an excessive pressure differential caused by extreme temperature changes.

4.2.6 The former contents and present vapor state of each tank, if known, or the gas-freing treatment and date should be indicated by an appropriate label on the tank.

#### 5—SALE OR REUSE

5.1 When tanks are sold for reuse, the purchaser should be given a very clear understanding of the former use and present condition of the tanks. It may or may not be necessary to test the tanks for flammable vapors or to gas-free them.

**CAUTION:** Tanks which previously contained leaded gasoline *must not* be used for the subsequent storage of food or liquids intended for animal or human consumption.

5.2 It is good business practice to use a bill of sale to transfer tank ownership, in which the purchaser will acknowledge and assume all liability related to the tank. Bills of sale should indicate the former use of the tank and carry

the following warning regardless of the condition of the tank.

Tank Has Contained Leaded Gasoline  
(or Flammable Liquid)\*  
Not Gas-Free  
Not Suitable for Food or Drinking Water

5.3 The tank should be clearly marked with the same warning as the bill of sale in legible letters not less than 1 inch high, regardless of the condition of the tank.

\* Use the applicable designation.

## 6—JUNKING

6.1 Tanks should be disposed of when they are no longer fit for the storage of flammable liquids or are considered junk. Whether sold to a junk or scrap dealer or discarded at an acceptable facility, sufficient holes should be made in tanks to render them unfit for further use.

6.2 When a tank is gas-free, it should be punctured with a pickax, chisel, or other heavy, sharp object, or many large holes may be drilled into it. When a tank is not gas-free, it should be filled with water until overflowing and punctured many times while full of water.

6.3 As an added precaution, regardless of the condition,

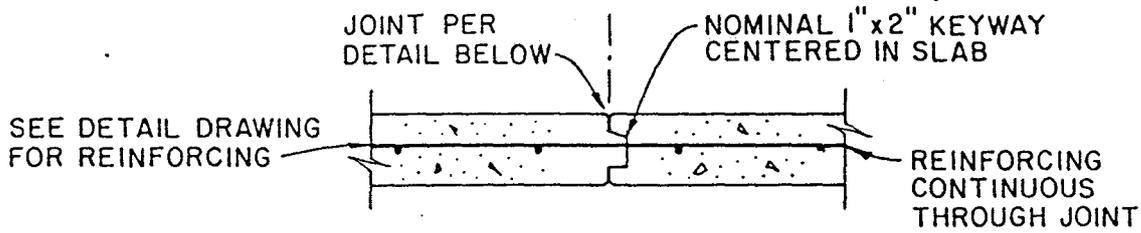
the tanks should be labeled in legible letters with the following information:

Tank Has Contained Leaded Gasoline  
(or Flammable Liquid)\*  
Not Gas-Free  
Not Suitable for Food or Drinking Water

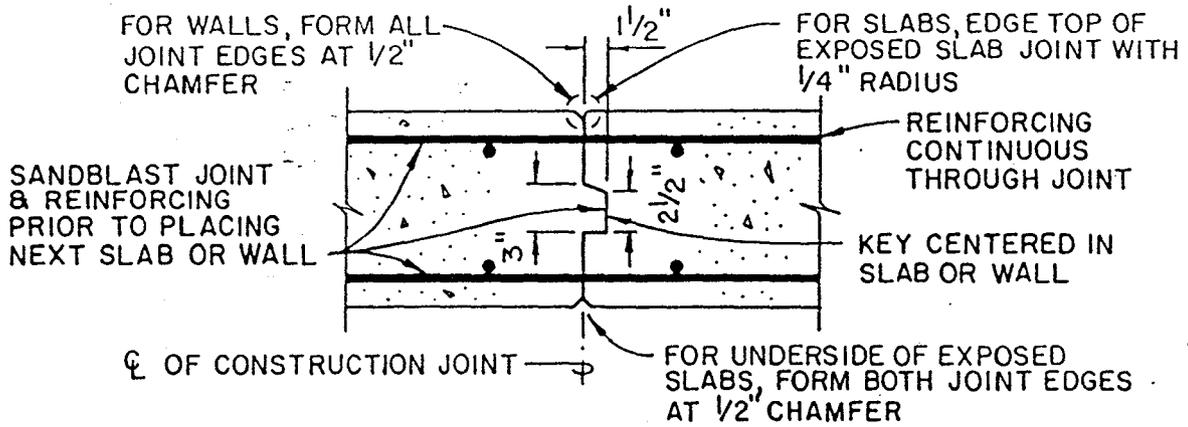
6.4 Prior to junking gasoline tanks, the latest applicable waste disposal regulations should be checked to determine if special attention or preparation is required.

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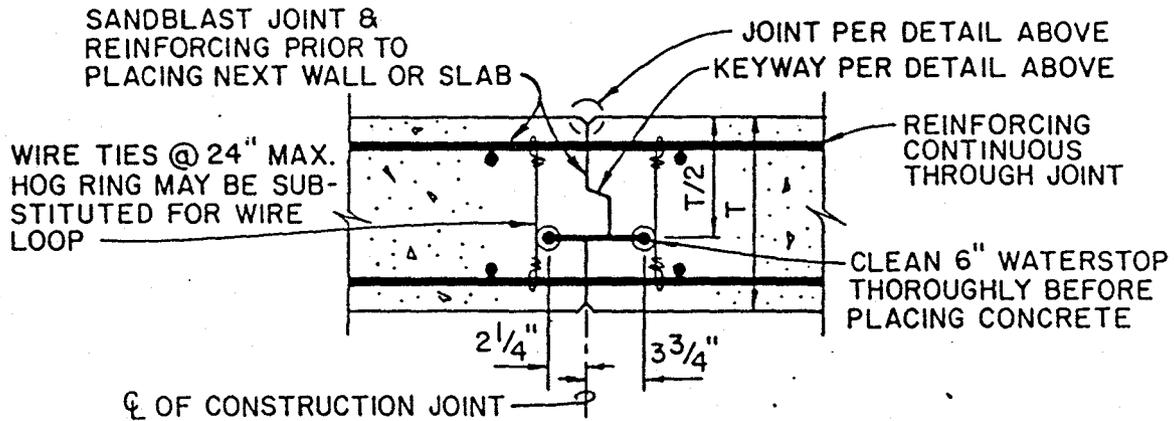
\* Use the applicable designation.



**WALL OR SLAB WITH SINGLE CURTAIN REINFORCING**



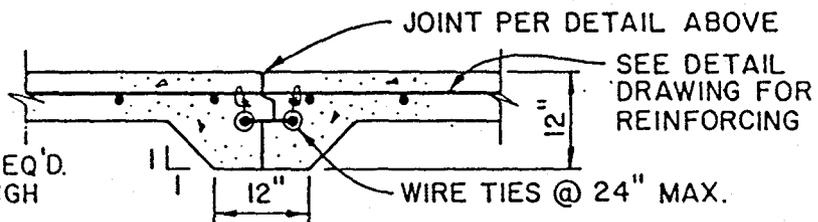
**SLAB OR WALL (NON WATER BEARING)**



**SLAB OR WALL (WATER BEARING)**

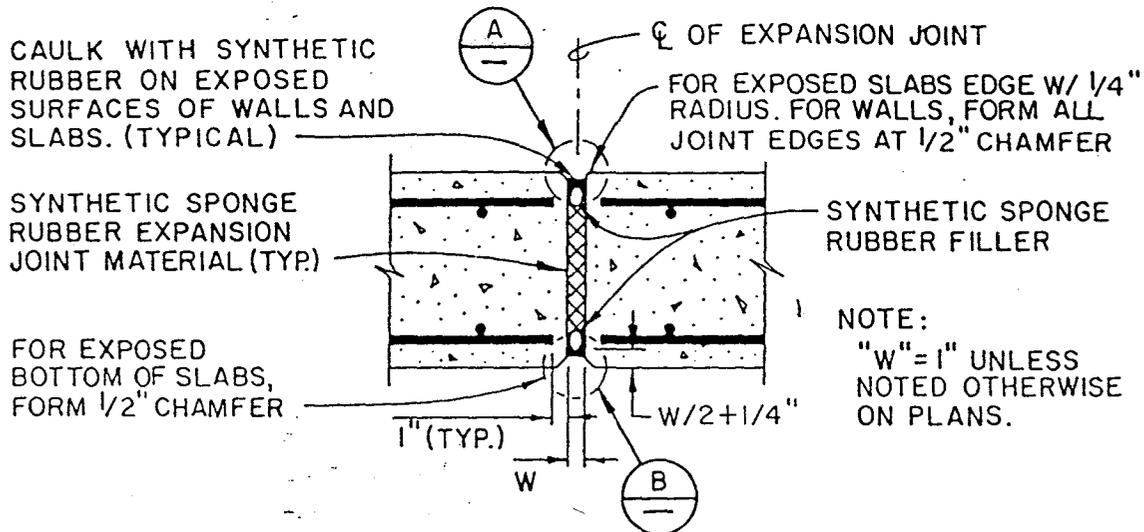
**NOTES:**

1. EMBED WATERSTOP FROM WALLS 6" INTO BASE SLAB AT POINTS WHERE THE WATERSTOP IS NOT REQ'D. TO CONTINUE THROUGH SLAB.

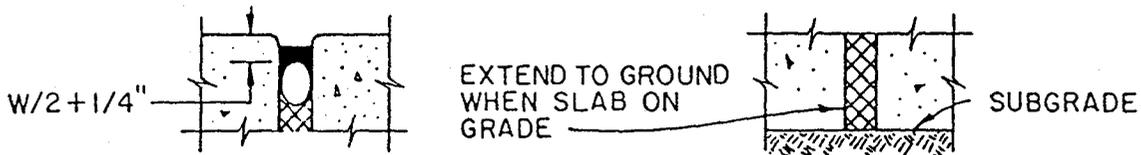


**SLAB THICKENING DETAIL**

**(WATER BEARING LESS THAN 12" THICK)**

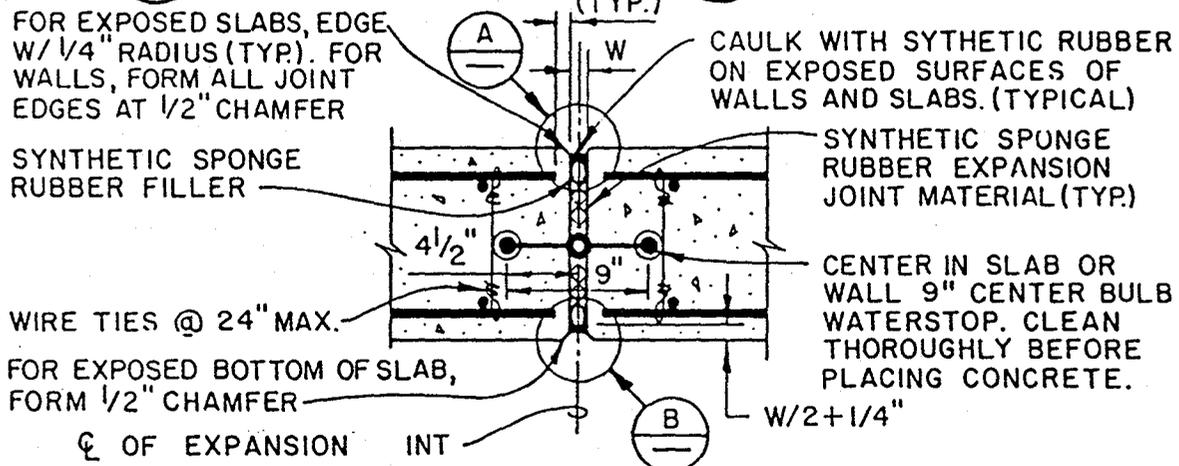


**NON WATER BEARING SLAB OR WALL**

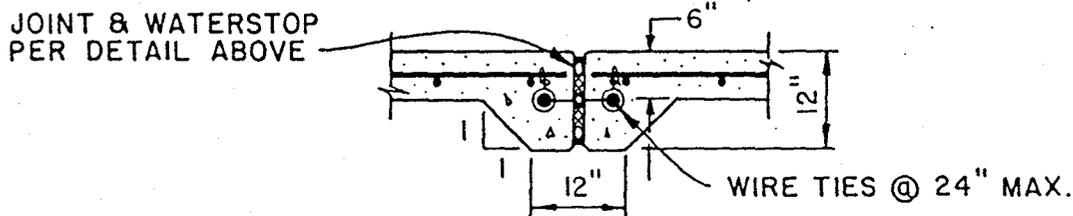


A  
DETAIL

B  
DETAIL - SLAB ON GRADE



**WATER BEARING SLAB OR WALL**



**SLAB THICKENING DETAIL**

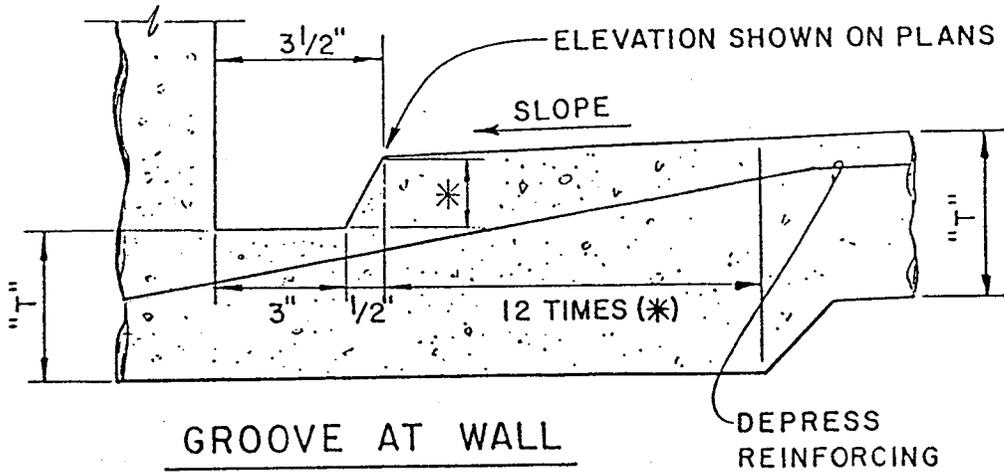
**WATER BEARING LESS THAN 12" THICK**

**EXPANSION JOINT**

22

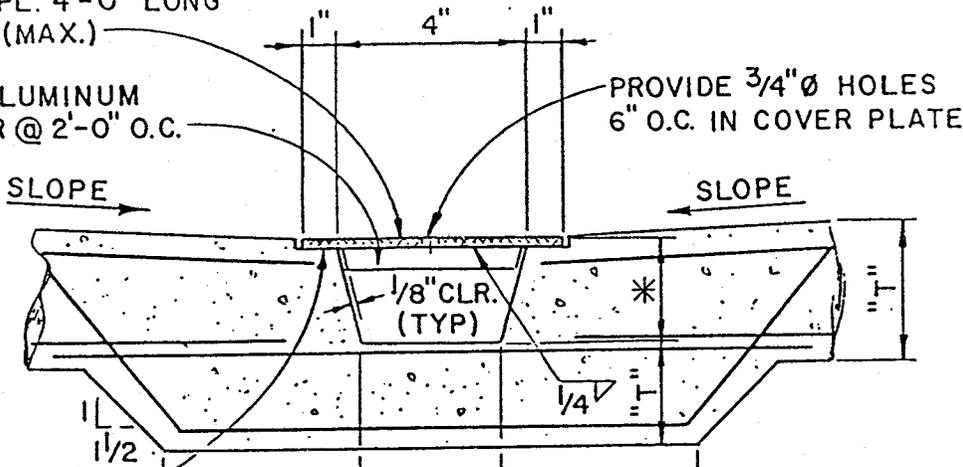
TYP

S 483



1/4" ALUM. PL. 4'-0" LONG SECTIONS (MAX.)

1/4" x 3/4" ALUMINUM STIFFENER @ 2'-0" O.C.



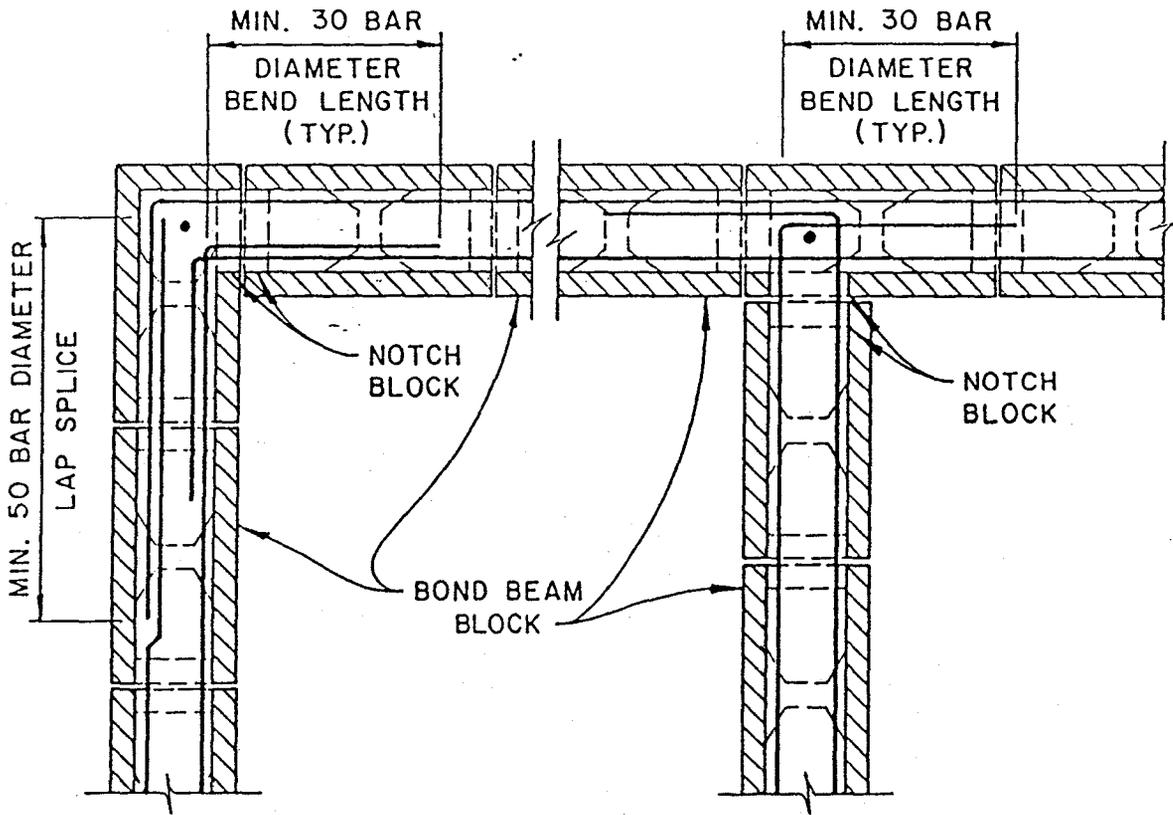
COAT PER NOTE-5 ON

120  
TYP.

\*1/2" MIN. SEE PLANS FOR ELEVATIONS OR DEPTH.

GROOVE IN SLAB

57 DRAINAGE GROOVE  
TYP s



CORNER

INTERSECTION

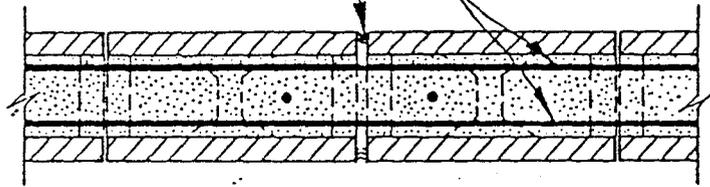
71  
TYP

MASONRY WALL BOND BEAM  
REINFORCING

S483

RAKE MORTAR FROM JOINT  
1/2" @ CONTROL JOINT AND  
CAULK PER NOTE BELOW

CONTINUOUS HORIZONTAL  
REINFORCING IN GROUTED  
BOND BEAM

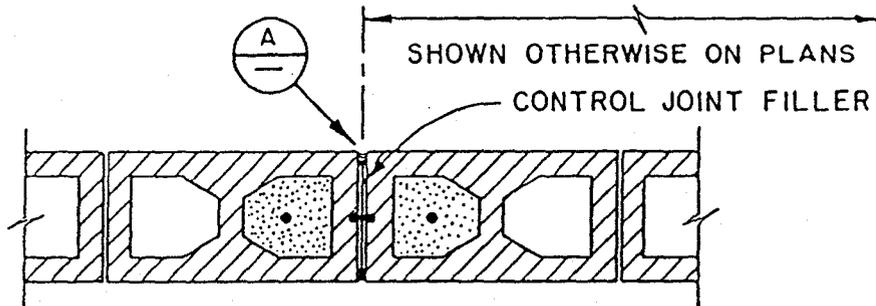


SECTION AT BOND BEAM

INSTALL @ 24' ± UNLESS

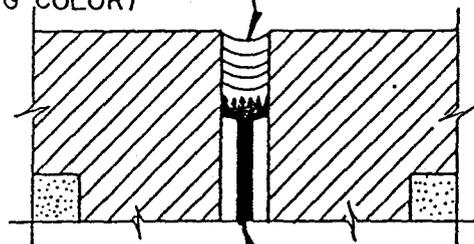
SHOWN OTHERWISE ON PLANS

CONTROL JOINT FILLER



SECTION ABOVE OR BELOW BOND BEAM

CAULK W/ SYNTHETIC RUBBER ON  
EXPOSED WALLS AFTER THOROUGH  
CLEANING (CAULKING SHALL MATCH  
CMU COLOR OR COATING COLOR)



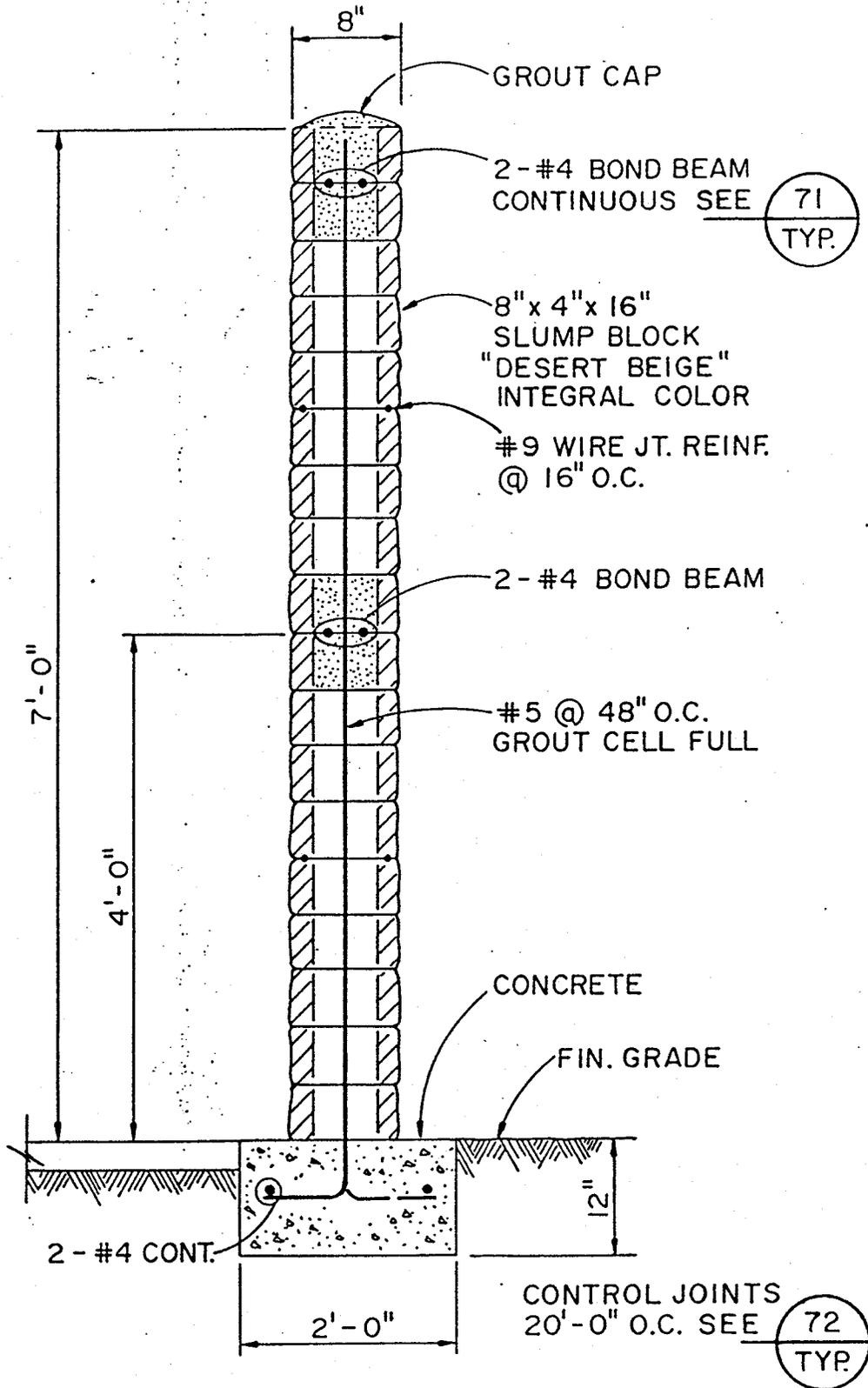
CONTROL JOINT FILLER

A  
—  
DETAIL

72  
TYP

MASONRY CONTROL JOINT

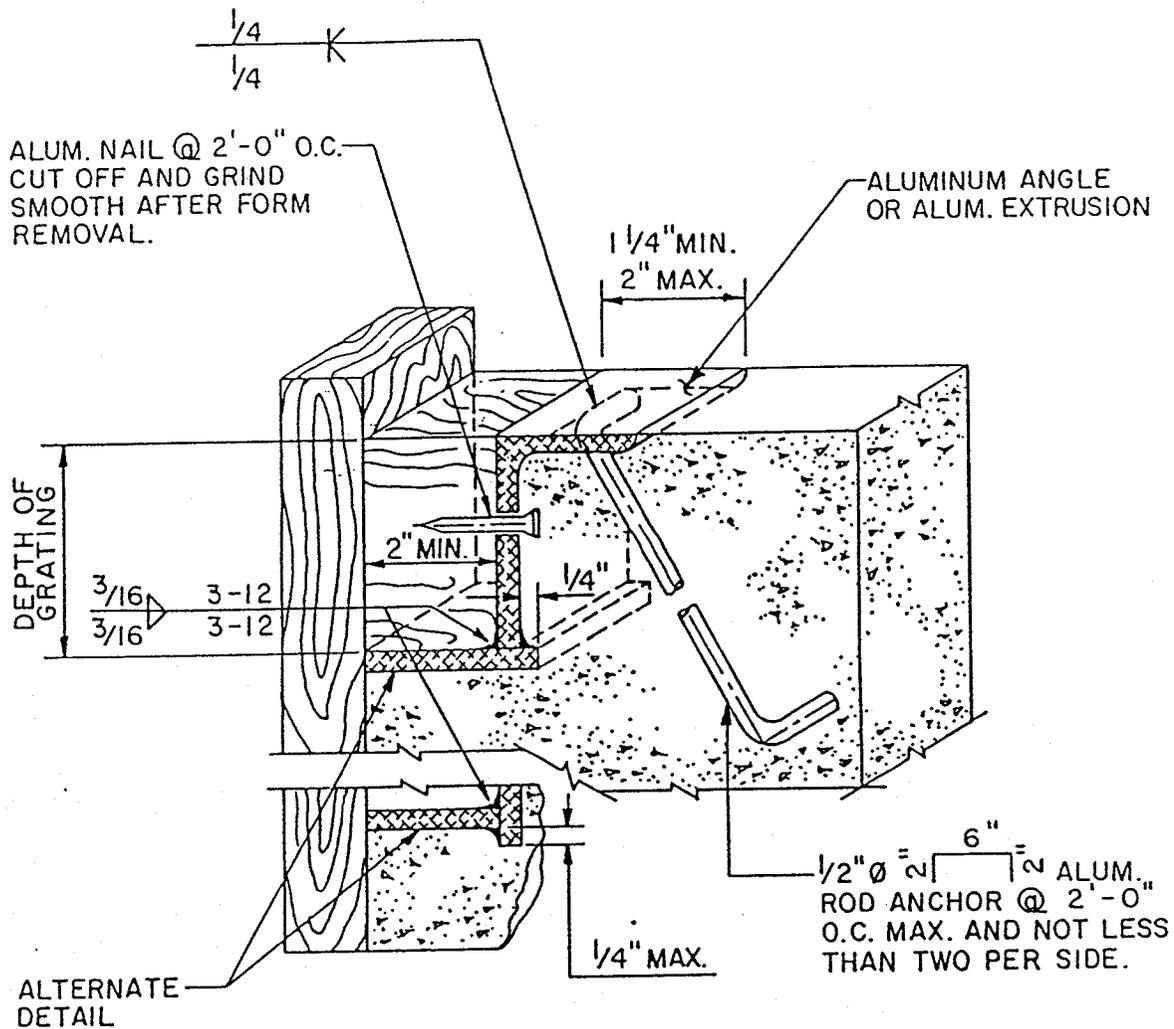
S483



85  
TYP.

WALL SECTION (FENCE)

72  
TYP.



NOTES:

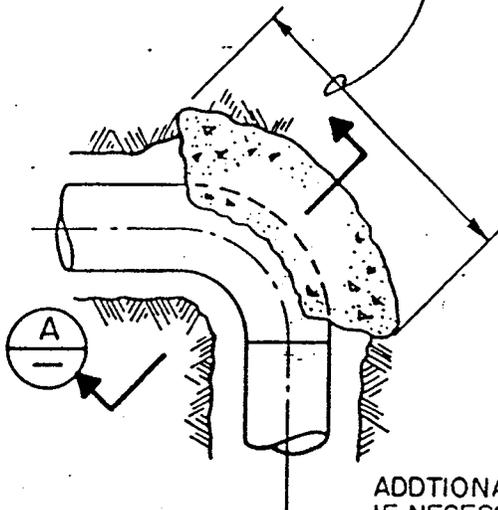
1. FOR GRATING SEE 122  
TYP
2. REBATE TO BE CONTINUOUS AROUND ENTIRE OPENING.
3. ALUMINUM ANGLE AND BEARING PLATE SHALL BE 1/4" THICK MIN.
4. REBATE MAY BE EXTRUDED, SUBJECT TO ENGINEER'S ACCEPTANCE.
5. COAT ALL ALUM. IN CONTACT WITH CONCRETE WITH TWO COATS OF ZINC CHROMATE PRIMER BEFORE INSTALLATION. PAINT SHALL BE SHERMAN WILLIAMS ZINC CHROMATE PRIMER B50 Y1, GLIDDEN NO. 5533 ZINC CHROMATE PRIMER OR APPROVED EQUAL.

120  
TYP. S483

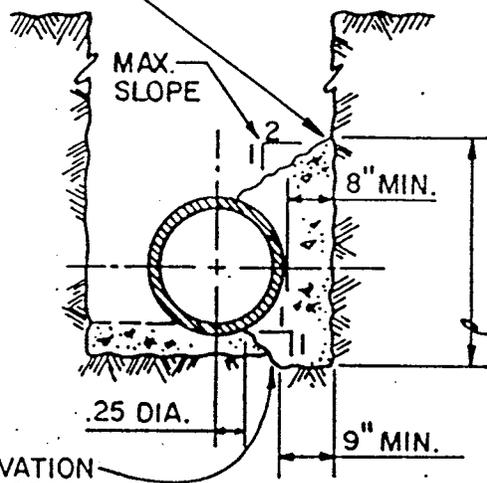
**GRATING REBATE**



LENGTH AS REQUIRED TO OBTAIN BEARING AREA AGAINST UNDISTURBED EARTH



POUR LEVEL WITH TOP OF PIPE OR SLOPE UP IF NECESSARY TO OBTAIN REQUIRED BEARING AREA

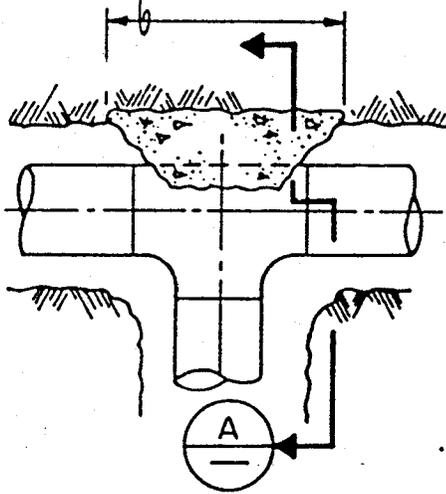


"H" AS REQ'D. TO OBTAIN BEARING AREA AGAINST UNDISTURBED EARTH.

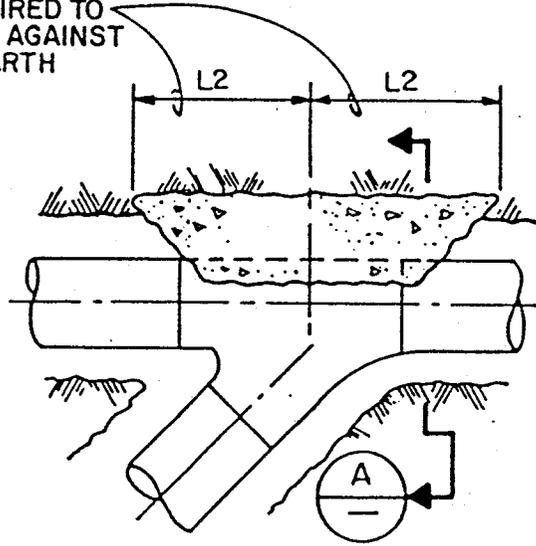
ADDITIONAL EXCAVATION IF NECESSARY TO OBTAIN REQUIRED BEARING AREA

**A** TYP. SECTION

LENGTH AS REQUIRED TO OBTAIN BEARING AGAINST UNDISTURBED EARTH

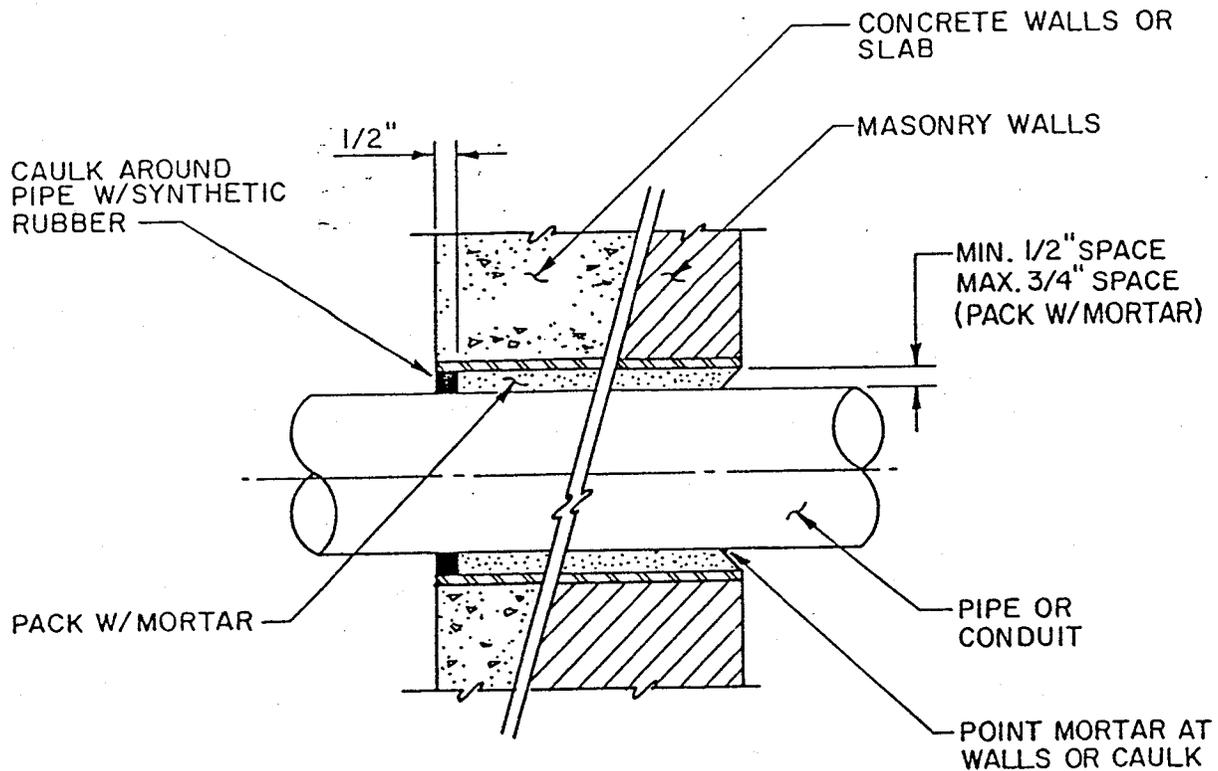


LENGTH AS REQUIRED TO OBTAIN BEARING AGAINST UNDISTURBED EARTH



**NOTES:**

1. BEARING AREA IS THE AREA REQUIRED TO OBTAIN A MAXIMUM SOIL LOADING OF 200 PSF PER FOOT OF DEPTH TO A MAXIMUM VALUE OF 1500 PSF WHEN THE PIPE IS SUBJECTED TO IT'S TEST PRESSURE OR BEARING AREA SHOWN ON PLANS. AREA MAY BE DECREASED IF SUBSTANTIATED BY SOIL BEARING TESTS.
2. CONCRETE SHALL BE CLASS "A" OR "C".



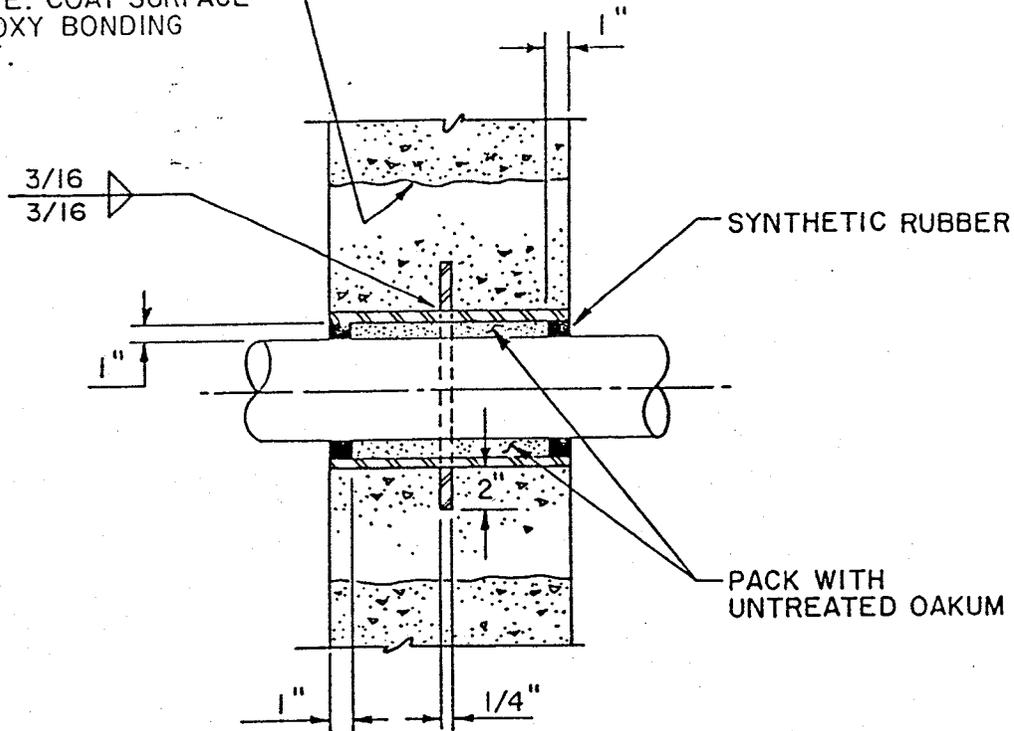
NOTES:

1. 6" Ø SLEEVES AND SMALLER - SCH. 40 STEEL PIPE OR SCH. 80 PVC/P.
2. 8" Ø SLEEVES AND LARGER - .25 THICK STEEL PIPE.
3. STEEL PIPE SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.
4. SLEEVE MAY BE OMITTED IF HOLE IS CORE DRILLED. CORE DRILLING IS SUBJECT TO ENGINEER'S ACCEPTANCE.

424  
TYP. S483

SLEEVE INSTALLATION THROUGH  
DRY WALLS & FLOOR SLABS

CUT OPENING AS REQ'D.  
THROUGH EXIST. WALLS.  
WELD REINF. BARS TO  
SLEEVE. COAT SURFACE  
W/ EPOXY BONDING  
AGENT.



NOTES:

1. FOR NEW CONSTRUCTION SLEEVES SHALL BE CAST INTO WALL. BLOCKOUTS AND SUBSEQUENT GROUTING IN OF SLEEVES WILL NOT BE PERMITTED UNLESS A KEYED WATERSTOP JOINT IS PROVIDED.
2. 6" Ø SLEEVES AND SMALLER SHALL BE SCH. 40 STEEL PIPE.
3. 8" Ø SLEEVE AND LARGER SHALL BE .25 THICK STEEL PIPE.
4. NEOPRENE LINK SEAL WITH STAINLESS STEEL BOLTS MAY BE SUBSTITUTED FOR OAKUM AND SYNTHETIC RUBBER SEAL.
5. SLEEVE SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.

425  
TYP.

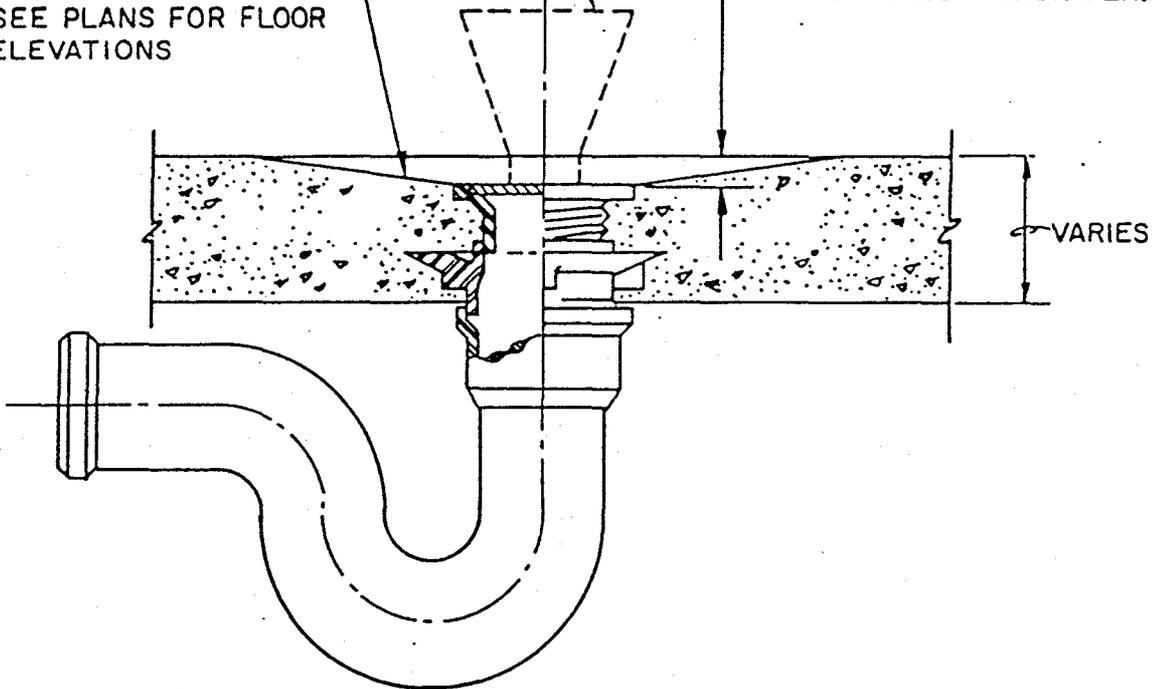
S483

SLEEVE INSTALLATION THROUGH WET  
WALL, WET SLAB, OR EXISTING WALL

FUNNEL ON EQUIPMENT DRAIN ONLY

FINISH FLOOR SLOPES  
TO FLOOR DRAIN AS  
SHOWN ON PLANS.  
SEE PLANS FOR FLOOR  
ELEVATIONS

SET TOP OF EQUIPMENT  
DRAIN 1" BELOW  
SURROUNDING FINISH FLR.



NOTE:

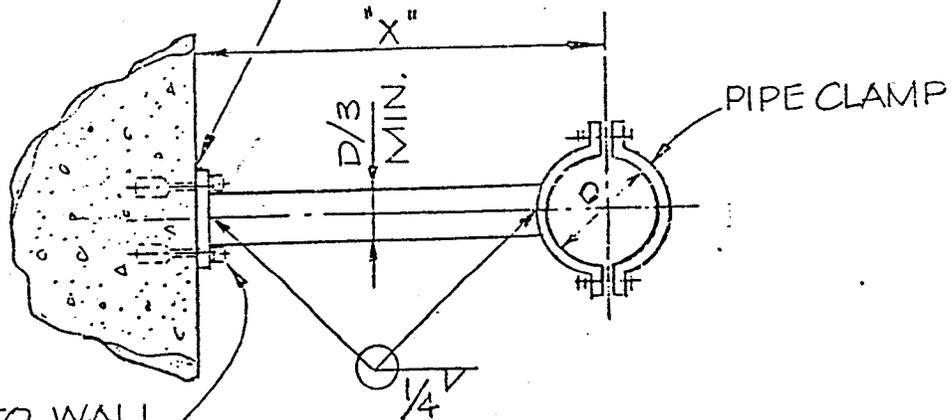
PROVIDE 12" RADIUS SLOPE TO EQUIPMENT DRAINS WHERE FLOOR  
DOES NOT SLOPE TO DRAIN.

441  
TYP.

S483

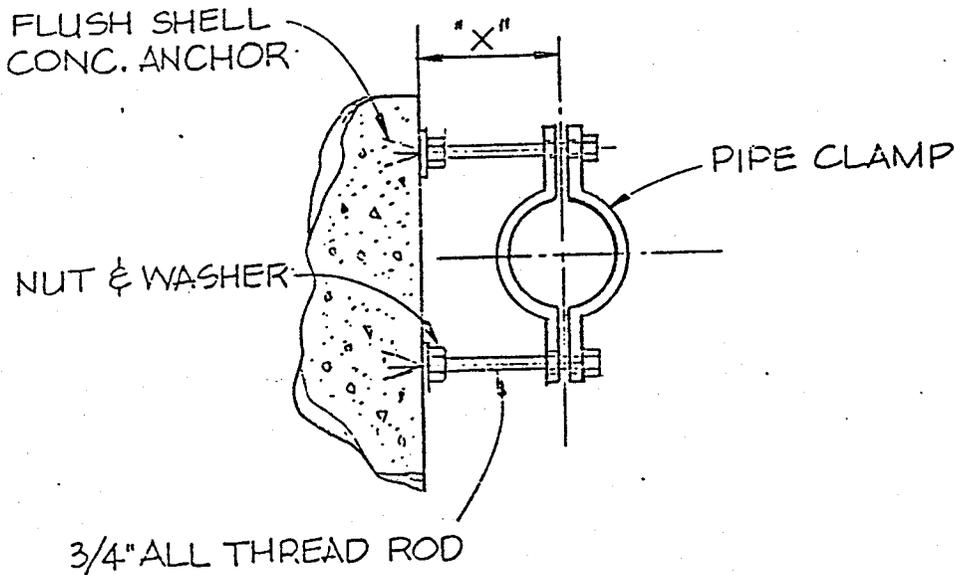
FLOOR DRAIN (F.D.) OR  
EQUIPMENT DRAIN (E.D.)

STL, @  $\frac{1}{4} \times D + 2$ " SQ FOR  
 8" & SMALLER PIPE  
 $\frac{1}{2} \times D$  FOR 10" & LARGER PIPE



ATTACH TO WALL  
 W/ 4  $\frac{1}{2}$ " X 6" BOLTS  
 IN CONC. ANCHORS

PLAN  
 FOR "X" GREATER THAN 12"

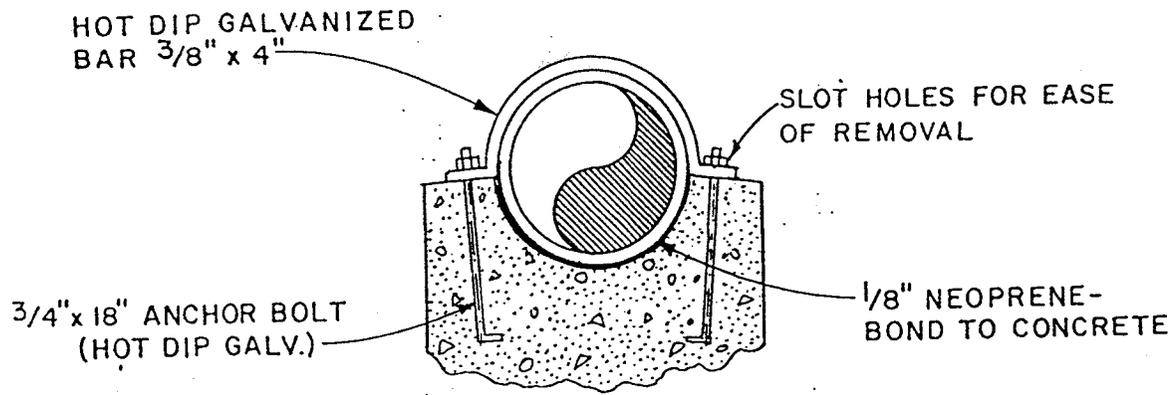


$\frac{3}{4}$ " ALL THREAD ROD

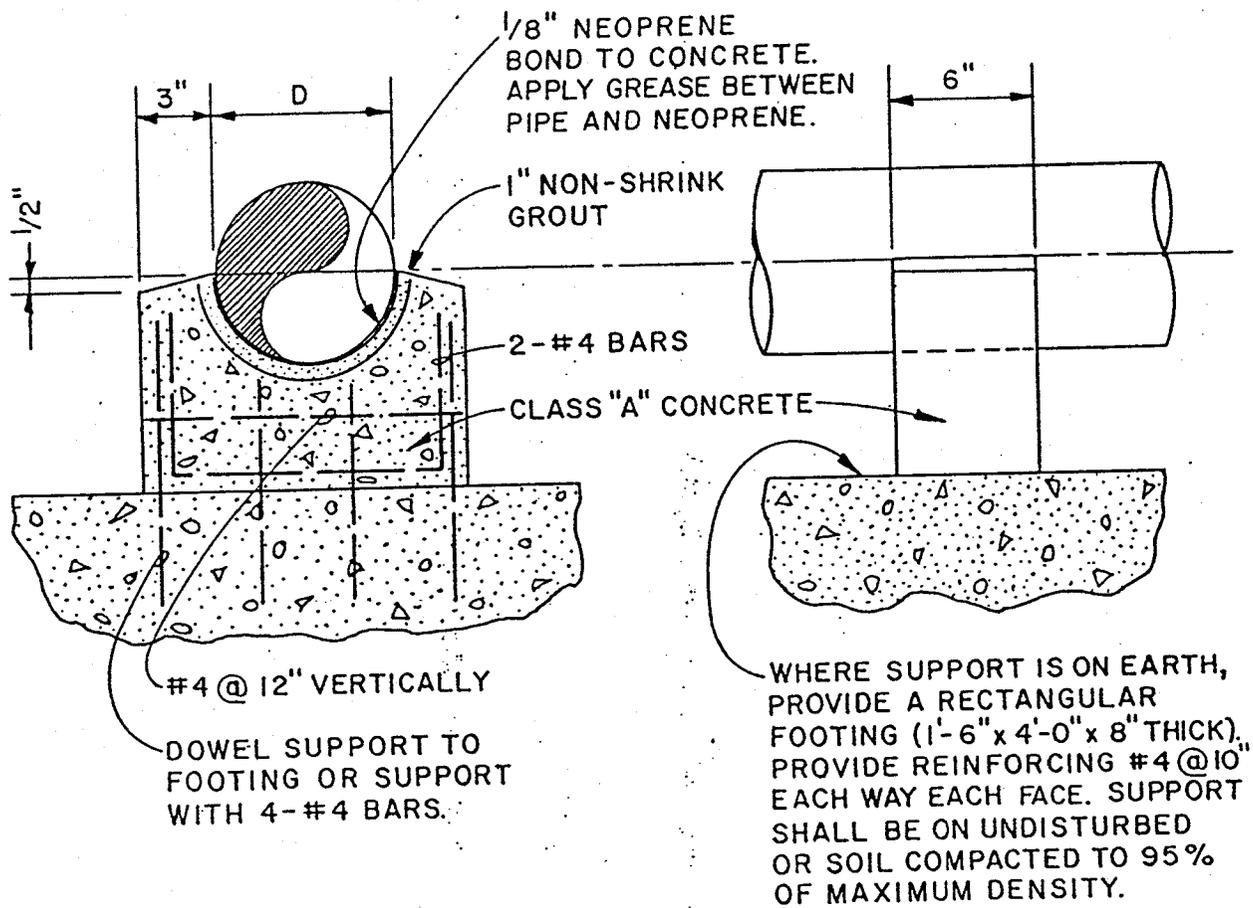
PLAN  
 FOR "X" 12" OR LESS

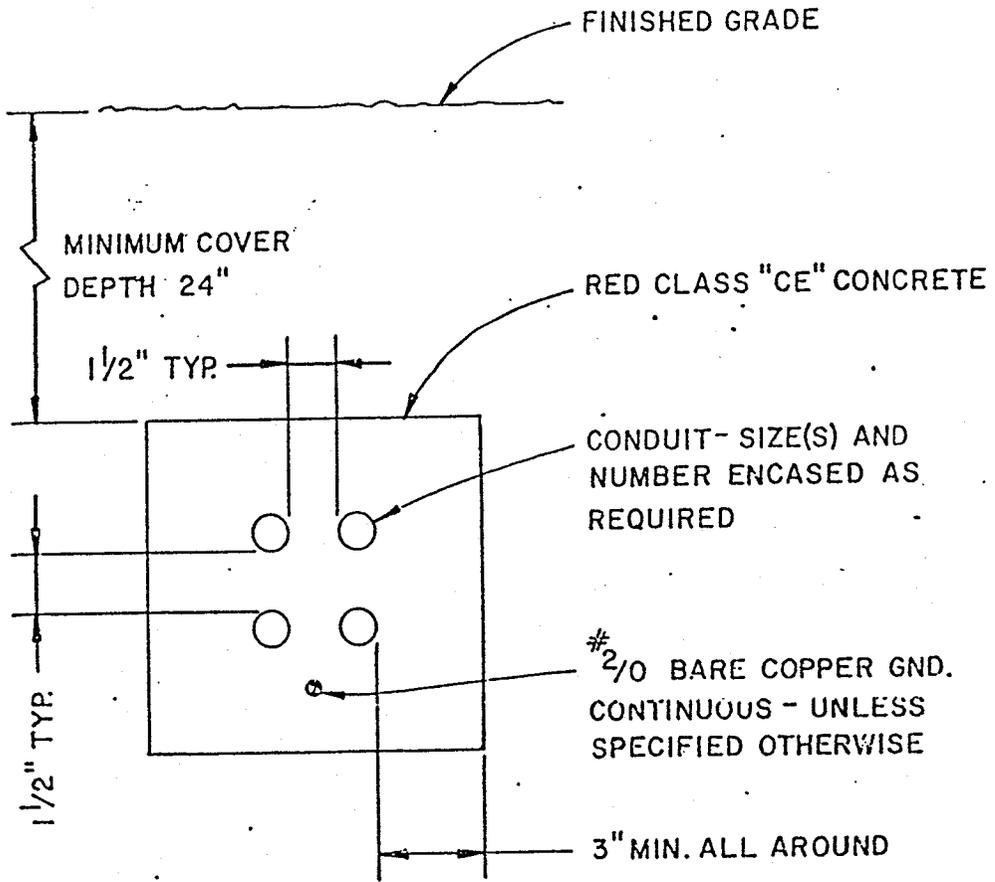
522  
 TYP.

VERTICAL PIPE SWAY BRACE



STRAP DETAIL-WHEN SPECIFIED





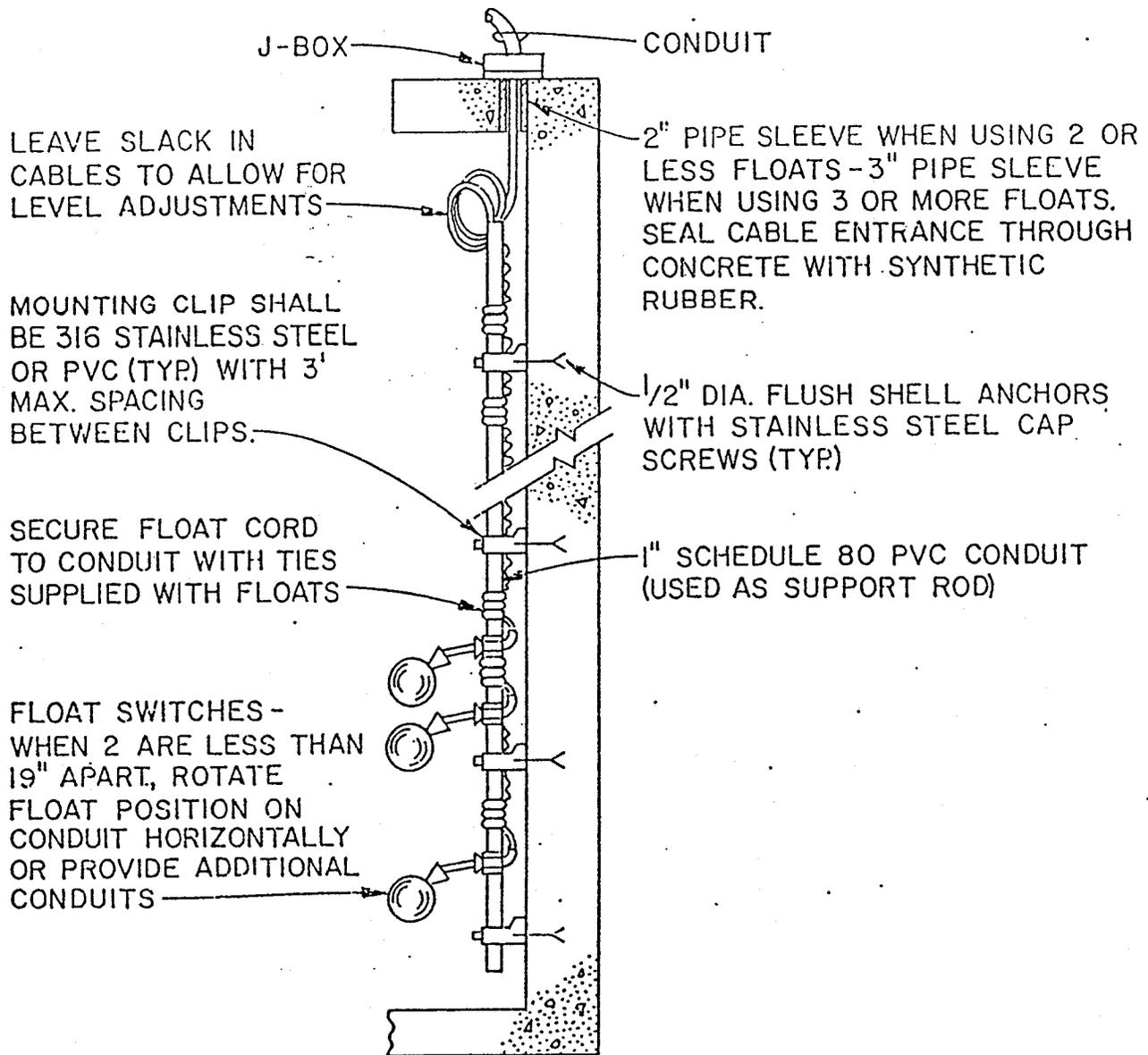
NOTE:

- I. ALL DIMENSIONS ARE MINIMUM, EXCEPT WHERE SHOWN OTHERWISE.

801  
 TYP<sub>s</sub>

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ENCASED ELECTRICAL CONDUITS



840  
TYP. s

## FLOAT SWITCH MOUNTING



CONTRACT FCD 88-24

THIS AGREEMENT, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_,  
by and between \_\_\_\_\_

of the City of \_\_\_\_\_, County of \_\_\_\_\_, State of \_\_\_\_\_,  
party of the first part, hereinafter designated the CONTRACTOR, and the FLOOD  
CONTROL DISTRICT OF MARICOPA COUNTY, acting by and through its BOARD OF  
DIRECTORS, a political subdivision of the State of Arizona, a body politic with  
corporate power, party of the second part, hereinafter designated OWNER.

WITNESSETH: That the said CONTRACTOR, for and in consideration of the sum  
to be paid him by the said OWNER, in the manner and at the time hereinafter  
provided, and of the other covenants and agreements hereincontained, and under  
the penalties expressed in the bonds provided, hereby agrees, for himself, his  
heirs, executors, administrators, successors, and assigns to as follows:

ARTICLE I-SCOPE OF WORK: The CONTRACTOR shall furnish any and all labor,  
materials, equipment, transportation, utilities, services and facilities  
required to perform all work for the construction of Project No. FCD 88-24  
7th Street Bridge and Utility Relocations at the ACDC,  
and to complete and totally construct the same and install the material therein  
for the OWNER, in a good and workmanlike and substantial manner and to the  
satisfaction of the OWNER through its Engineers and under the direction and  
supervision of the Engineer, or his properly authorized agents and strictly  
pursuant to and in conformity with the Plans and Specifications prepared by the  
Engineers for the OWNER, and with such modifications of the same and other  
documents that may be made by the OWNER through the Engineer or his properly  
authorized agents, as provided herein.

ARTICLE II-CONTRACT DOCUMENTS: The Invitation for Bids, Plans, Standard  
Specifications and Details, Special Provisions, Addenda, if any, and Proposal,  
as accepted by the BOARD OF DIRECTORS, Performance Bond, Payment Bond,  
Certificates of Insurance, and Change Orders, if any, are by this reference  
made a part of this Contract to the same extent as if set forth herein in full.

ARTICLE III-TIME OF COMPLETION: The CONTRACTOR further covenants and agrees  
at his own proper cost and expense, to do all work as aforesaid for the con-  
struction of said improvements and to completely construct the same and install  
the material therein, as called for by this agreement free and clear of all  
claims, liens, and charges whatsoever, in the manner and under the conditions  
specified within the time, or times, stated in the proposal pamphlet.

ARTICLE IV-PAYMENTS: For and in consideration of the faithful performance  
of the work herein embraced as set forth in the Contract Documents, which are a  
part hereof and in accordance with the directions of the OWNER, through its  
Engineer and to his satisfaction, the OWNER agrees to pay the said CONTRACTOR  
the amount earned, computed from actual quantities of work performed and  
accepted or materials furnished at the unit bid price on the Proposal made a  
part hereof, and to make such payment within forty (40) days after final  
inspection and acceptance of the work.

IN WITNESS WHEREOF: Four (4) identical counterparts of this Contract each of which shall for all purposes be deemed an original thereof, have been duly executed by the parties hereinabove named, on the date and year first above written.

The CONTRACTOR agrees that this Contract, as awarded, is for the stated work, and understands that payment for the total work will be made on the basis of the indicated amount(s), as bid in the Proposal.

PARTY OF THE FIRST PART

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
PARTY OF THE SECOND PART

\_\_\_\_\_

By: \_\_\_\_\_  
Chairman, Board of Directors

Date: \_\_\_\_\_

RECOMMENDED BY:

ATTEST:

\_\_\_\_\_  
Chief Engineer and General Manager  
Flood Control District  
of Maricopa County

\_\_\_\_\_  
Clerk of the Board

Date: \_\_\_\_\_

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District of Maricopa County.

By: \_\_\_\_\_

Date: \_\_\_\_\_

CONTRACT NO. FCD 88-24

STATUTORY PERFORMANCE BOND PURSUANT TO TITLE 34  
CHAPTER 2, ARTICLE 2, OF THE ARIZONA REVISED STATUTES  
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

That, \_\_\_\_\_  
(hereinafter called the Principal), as Principal, and

\_\_\_\_\_ a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_ (hereinafter called the Surety), as Surety, are held and firmly bound unto the Flood Control District of Maricopa County, in the County of Maricopa, State of Arizona, in the amount of \_\_\_\_\_ dollars (\$ \_\_\_\_\_), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Flood Control District of Maricopa County, dated the \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, for FCD No. 88-24, 7th Street Bridge and Utility Relocation at the

ACDC

\_\_\_\_\_ which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extension thereof, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; then the above obligation shall be void, otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, of the Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of said Title, Chapter, and Article, to the extent as if it were copied at length herein.

The prevailing party in a suit on this bond shall be entitled to such reasonable attorney's fees as may be fixed by a judge of the court.

Witness our hands this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_  
AGENCY OF RECORD

\_\_\_\_\_  
AGENCY ADDRESS

CONTRACT NO. FCD 88-24  
PERFORMANCE BOND

\_\_\_\_\_  
PRINCIPAL

\_\_\_\_\_  
SEAL

BY: \_\_\_\_\_

\_\_\_\_\_  
SURETY

\_\_\_\_\_  
SEAL

BY: \_\_\_\_\_

\_\_\_\_\_  
POWER OF ATTORNEY

\_\_\_\_\_  
SEAL

BY: \_\_\_\_\_

STATUTORY PAYMENT BOND PURSUANT TO TITLE 34  
CHAPTER 2, ARTICLE 2, OF THE ARIZONA REVISED STATUTES  
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS:

That, \_\_\_\_\_  
(hereinafter called the Principal), as Principal, and

\_\_\_\_\_ a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_, (hereinafter called the Surety), as Surety, are held and firmly bound unto the Flood Control District of Maricopa County, State of Arizona (hereinafter called the Obligee) in the amount of \_\_\_\_\_ dollars (\$ \_\_\_\_\_), for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, for FCD No. 88-24

7th Street Bridge and Utility Relocations at the ACDC

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall promptly pay all moneys due to all persons supplying labor or materials to him or his subcontractors in the prosecution of the work provided for in said contract, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, of the Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions, of said Title, Chapter, and Article, to the extent as if it were copied at length herein.

The prevailing party or any party which recovers judgment on this bond shall be entitled to such reasonable attorney's fees as may be fixed by the court or a judge thereof.

Witness our hands this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_  
PRINCIPAL SEAL

BY: \_\_\_\_\_

\_\_\_\_\_  
AGENCY OF RECORD

\_\_\_\_\_  
SURETY SEAL

BY: \_\_\_\_\_

\_\_\_\_\_  
AGENCY ADDRESS

\_\_\_\_\_  
POWER OF ATTORNEY SEAL

BY: \_\_\_\_\_

CONTRACT NO. FCD 88-24  
PAYMENT BOND

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CERTIFICATE OF INSURANCE

7th Street Bridge and Utility

CONTRACT FCD 88-24

PROJECT TITLE

Relocations at the ACDC

|                                      |   |
|--------------------------------------|---|
| NAME AND ADDRESS OF INSURANCE AGENCY | INSURANCE COMPANIES AFFORDING COVERAGES |
|                                      | Company Letter <b>A</b>                 |
|                                      | Company Letter <b>B</b>                 |
|                                      | Company Letter <b>C</b>                 |
|                                      | Company Letter <b>D</b>                 |
|                                      | Company Letter <b>E</b>                 |
|                                      | Company Letter <b>F</b>                 |
| NAME AND ADDRESS OF INSURED          | Company Letter <b>D</b>                 |
|                                      | Company Letter <b>E</b>                 |
|                                      | Company Letter <b>F</b>                 |
| Company Letter <b>G</b>              |   |

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE AND ARE IN FORCE AT THIS TIME.

| COMPANY LETTER | TYPE OF INSURANCE  | POLICY NUMBER | EXPIRATION DATE | LIMITS OF LIABILITY IN \$1,000   |   |
|----------------|--|---------------|-----------------|--|---|
|                |  |               |                 | MINIMUM  | each occurrence   |
|                | <input checked="" type="checkbox"/> COMPREHENSIVE GENERAL LIABILITY FORM<br><input checked="" type="checkbox"/> PREMISES OPERATIONS<br><input checked="" type="checkbox"/> CONTRACTUAL<br><input checked="" type="checkbox"/> BROAD FORM PROPERTY DAMAGE<br><input checked="" type="checkbox"/> EXPLOSION & COLLAPSE<br><input checked="" type="checkbox"/> PRODUCTS/COMPLETED OPERATIONS HAZARD<br><input checked="" type="checkbox"/> UNDERGROUND HAZARD<br><input checked="" type="checkbox"/> INDEPENDENT CONTRACTORS<br><input checked="" type="checkbox"/> PERSONAL INJURY |               |                 | BODILY INJURY per person<br>each occurrence<br>PROPERTY DAMAGE<br>OR<br>BODILY INJURY AND PROPERTY DAMAGE Combined | <del>\$500</del><br><del>\$1,000</del><br><del>\$500</del><br>\$1,000 |
|                | <input checked="" type="checkbox"/> COMPREHENSIVE AUTO LIABILITY & NON-OWNED   |               |                 | SAME AS ABOVE  |   |
|                | <input type="checkbox"/> EXCESS LIABILITY  |               |                 | NECESSARY IF UNDERLYING NOT ABOVE MINIMUM  |   |
|                | <input checked="" type="checkbox"/> WORKERS' COMPENSATION and EMPLOYERS' LIABILITY   |               |                 | STATUTORY<br>each accident   | \$100   |
|                | <input type="checkbox"/> OTHER   |               |                 |  |   |

1000  
5000  
1000  
5000

The Flood Control District of Maricopa County is added as an additional insured as respects work done for the District by the named insured as required by statute, contract, purchase order or otherwise requested. It is agreed that any insurance available to the named insured shall be primary of other sources that may be available. It is further agreed that no policy shall expire, be cancelled or materially changed to effect the coverage available to the District without fifteen days written notice to the District. THIS CERTIFICATE IS NOT VALID UNLESS COUNTERSIGNED BY AN AUTHORIZED REPRESENTATIVE OF THE INSURANCE COMPANY.

NAME AND ADDRESS OF CERTIFICATE HOLDER  
 FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
 3335 West Durango Street  
 Phoenix, Arizona 85009

DATE ISSUED \_\_\_\_\_

AUTHORIZED REPRESENTATIVE \_\_\_\_\_

It is further agreed that:

The Contractor hereby agrees to indemnify and save harmless the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, or any of its departments, agencies, officers or employees, from and against all loss, expense, damage or claim of any nature whatsoever which is caused by any activity, condition or event arising out of the performance or nonperformance of any of the provisions of this Agreement. The Flood Control District of Maricopa County shall in all instances be indemnified against all liability, losses and damages of any nature for or on account of any injuries to or death of persons or damages to or destruction of property arising out of or in any way connected with the performance or nonperformance of this Agreement, except such injury or damage as shall have been occasioned by the negligence of the Flood Control District of Maricopa County. The above cost of damages incurred by the Flood Control District of Maricopa County or any of its departments, agencies, officers or employees shall include in the event of an action, court costs, expenses for litigation and reasonable attorney's fees.

Date \_\_\_\_\_ Contractor \_\_\_\_\_

CERTIFICATE OF INSURANCE  
CONTRACT FCD 88-24